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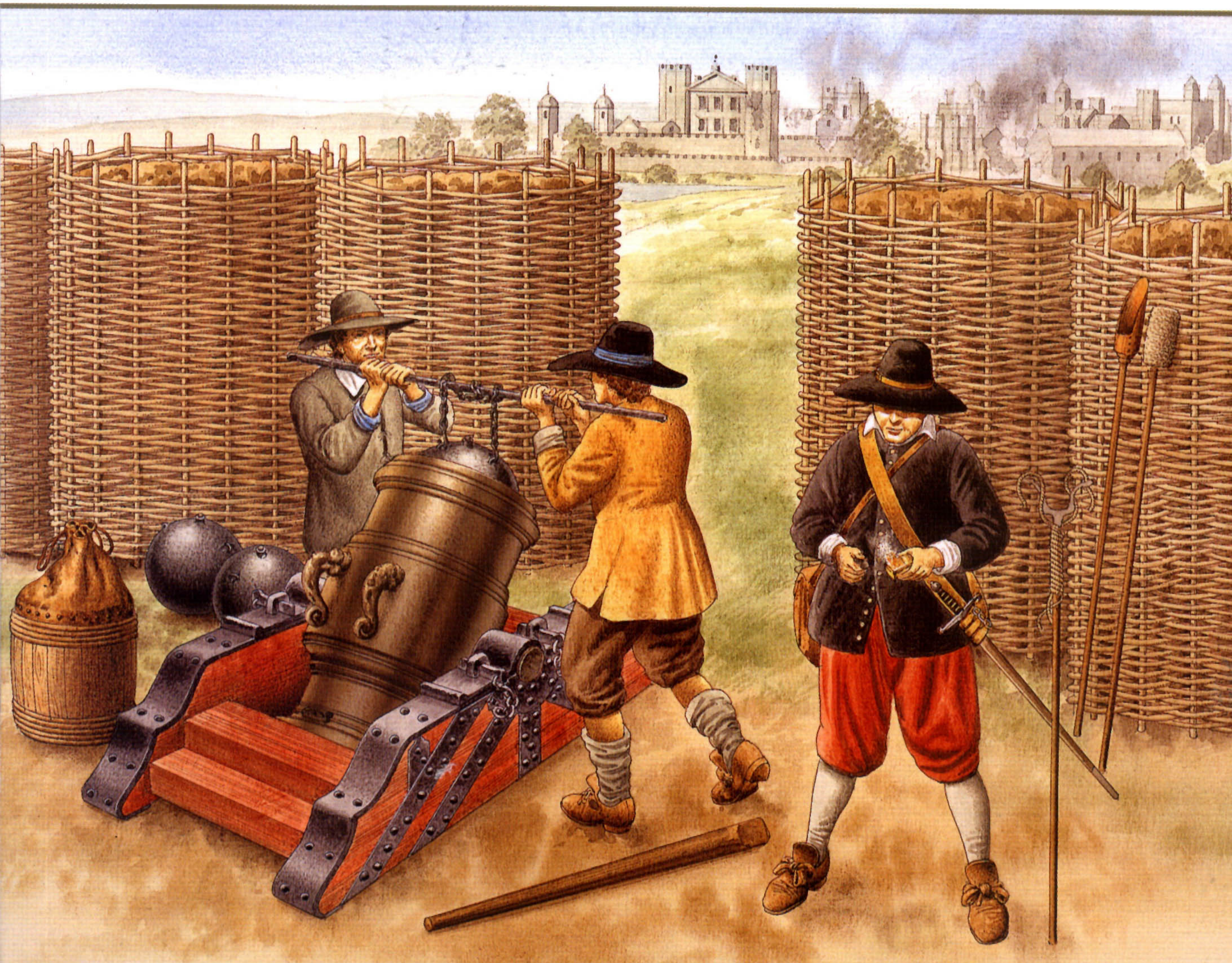
English Civil War Artillery 1642–51



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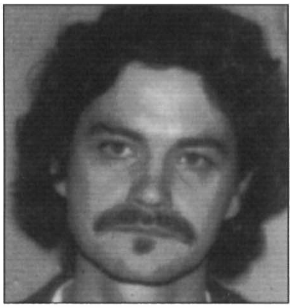

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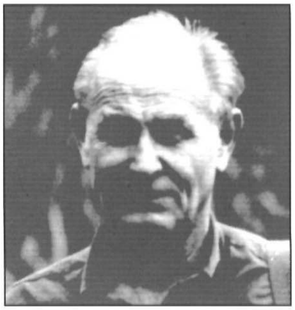

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CONTENTS

INTRODUCTION 3

MANUFACTURE 4

GUN CASTING 5

GUN TYPES 9

CARRIAGES 13

LIGHT FIELD GUNS 16

NAVAL CARRIAGES 18

AMMUNITION AND TOOLS 18

TRANSPORT 21

DRILL 24

TACTICS 35

ORGANIZATION 38

SIEGES 39

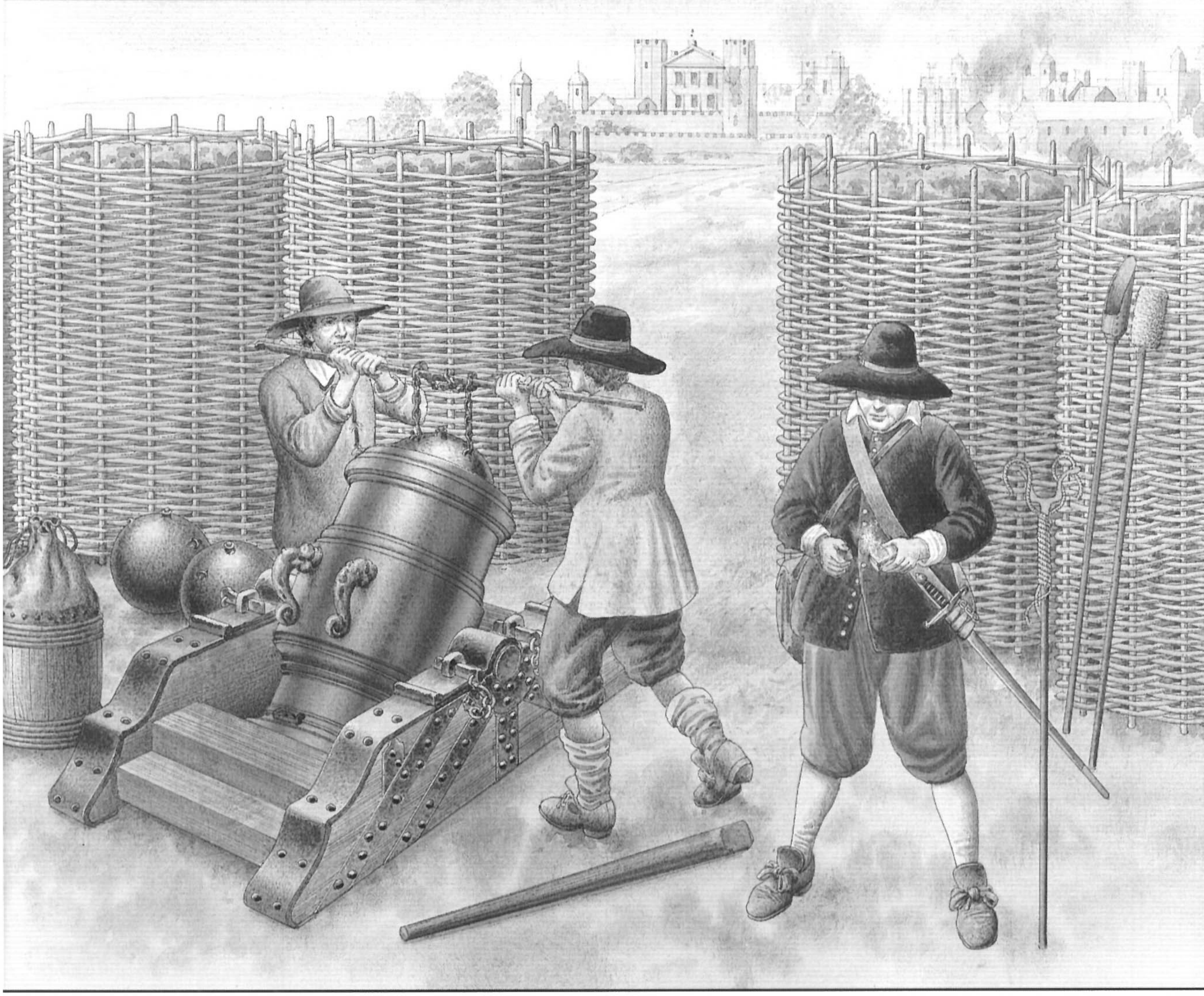
BIBLIOGRAPHY 42

GLOSSARY 44

COLOUR PLATE COMMENTARY 45

INDEX 48

English Civil War Artillery 1642–51



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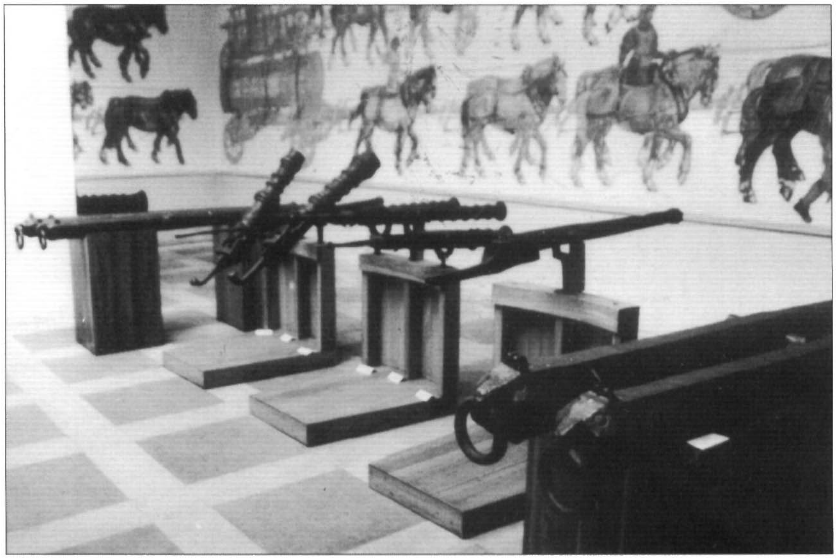
ENGLISH CIVIL WAR ARTILLERY
1642–51

INTRODUCTION

The English Civil War is an event that has been celebrated in the British Isles most notably for the fundamental change it wrought in the process of government. However, the author Christopher Hill called his book on the subject *The World Turned Upside Down* and to many people who lived through the war it must have appeared that their own world was indeed turned upside down. Many of the towns and villages of the country were razed by one side or the other, while financial extortion, religious polarization and upheaval were the order of the day. Militarily, it was a long drawn out affair in which the Parliamentarian faction gained the upper hand only after several years of bitter conflict. It achieved this by imposing new forms of discipline and organization on its armies and establishing them under one authority as the New Model Army. Most military forces during the period were normally composed of infantry, cavalry and artillery. At the beginning of the war it was clear that artillery was to play a significant part in this conflict, which was so heavily weighted in favour of the siege. Both Royalist and Parliamentarian factions raced to control ordnance stores in places such as London and Hull. Once control was gained, the use of such ordnance could be decisive in the siege warfare that later developed. This book is intended to give the reader an overview of the types of weapon used in this conflict and, as importantly, as clear a picture as possible of how artillery might have been used in the 17th century.



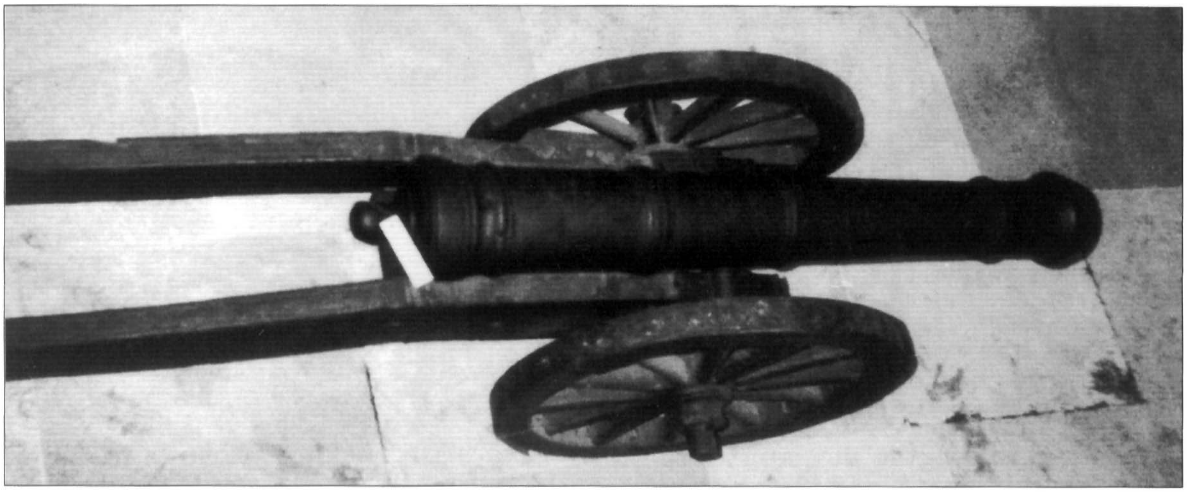
A collection of bronze and iron guns in the Army Museum in Vienna. The wrought iron breech-loaders at the left are almost exactly the same construction as those found in coastal waters in Britain and have been attributed to the 17th century. (Author's photograph)

It is a simple matter to divide the types of artillery into two categories, that is, field and siege artillery. Field artillery was considered light enough to be drawn into a battle and deployed there. We could divide the field guns into two further groups, defined by the type of gun: positional, or those that were placed in the battle line but not moved, and mobile, those that attended the infantry and moved with it. The use of field artillery is a somewhat controversial affair since several writers have claimed that it was of limited use on the battlefield. Siege artillery was too heavy to be used in the field and had to be transported specifically to a siege by a very large artillery train consisting of wagons, animals and all of the personnel to go with them.

MANUFACTURE

The majority of guns used during the English Civil War were cast in bronze, a mixture of copper and tin, or iron. In the reign of Henry VIII the Weald area of Sussex had become the centre for the production of reliable cast iron guns and Britain had become a leader in iron gun production, so much so that she was able to export weapons to the Continent, where English guns had become the preferred military item. By the middle of the 17th century, however, this situation had changed. From 1629 English guns were no longer as widely available owing to an energy shortage in the Weald area. The serious deforestation involved in burning wood for charcoal had to be restricted and the Dutch, ever with an eye to trade, saw their opportunity to introduce guns cast in Sweden under the direction of Dutch merchants. These guns were known as finbankers and it is likely that many found their way into the armies of both sides during the Civil War.

Bronze guns were widely available and many famous English founders supplied them to both sides. Foremost amongst these was John Browne of Brenchley, Horsmonden, in Kent. He was the son of Thomas Browne and was granted a monopoly for casting guns for the navy in 1614. He became a royal gunfounder in 1618 and initially served Charles I but was then ordered by Parliament to cast guns for them during the



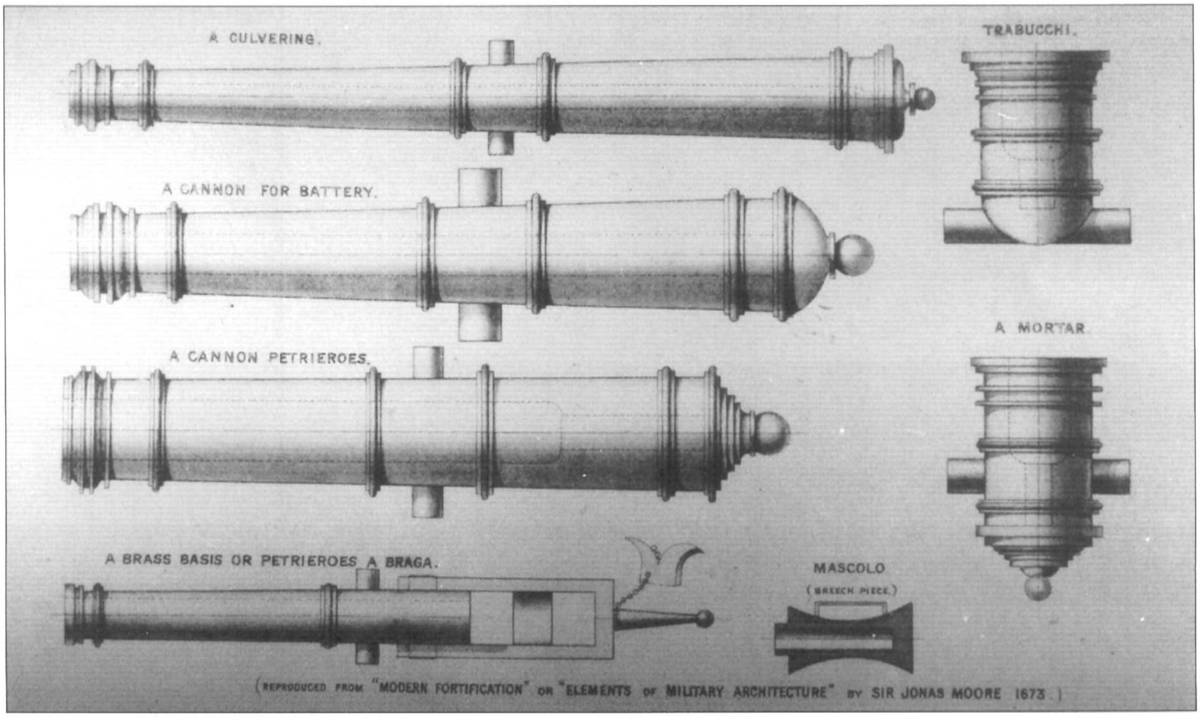
A small minion in the armoury of the Grand Palace at Valetta, Malta. The carriage may well be original and the carriage construction bears a close resemblance to those weapons used with infantry units in the Civil War.

Civil Wars. Browne was really more of an entrepreneur than a craftsman but he certainly experimented with guns and was awarded a prize of £200 for helping to make iron guns less weighty for the navy. However, how he did this has been lost to us. There were several members of the Browne family who cast guns in bronze and iron. A second family worth mentioning was the Pitt dynasty that was based in Houndsditch in London. Henry Pitt worked within the Tower of London and the two younger Pitts, son and nephew (both called Richard), were certainly casting during the Civil War. When King Charles moved to Oxford, one of the first things he did was to attempt to create a gun foundry at Frewin Hall so that he would not be reliant upon foreign imports. If we add to this the many foreign gunfounders and merchants supplying equipment to the King and Parliament we can see that there would have been a great deal of variation in the armament of both sides during this conflict.

GUN CASTING

Since muzzle-loading smooth bore guns were the most commonly encountered form of artillery used during the war, it would not be out of place to describe the casting process that produced them. Bronze and iron gun casting processes were very similar and both started with the manufacture of a model. The model of the gun was made of wood built up with clay. The clay was built up on a wooden spindle, which was sometimes a reused ship's spar. This was greased and then wound with rope. It was then suspended between two trestles and continually turned while a mixture of loam and horsehair was added to the rope surface to build up a model of the gun. Once the clay model had reached the right

A nice representation of 17th-century gun types with a culverin, cannon, perrier and two types of mortar and showing the different proportions of each weapon.

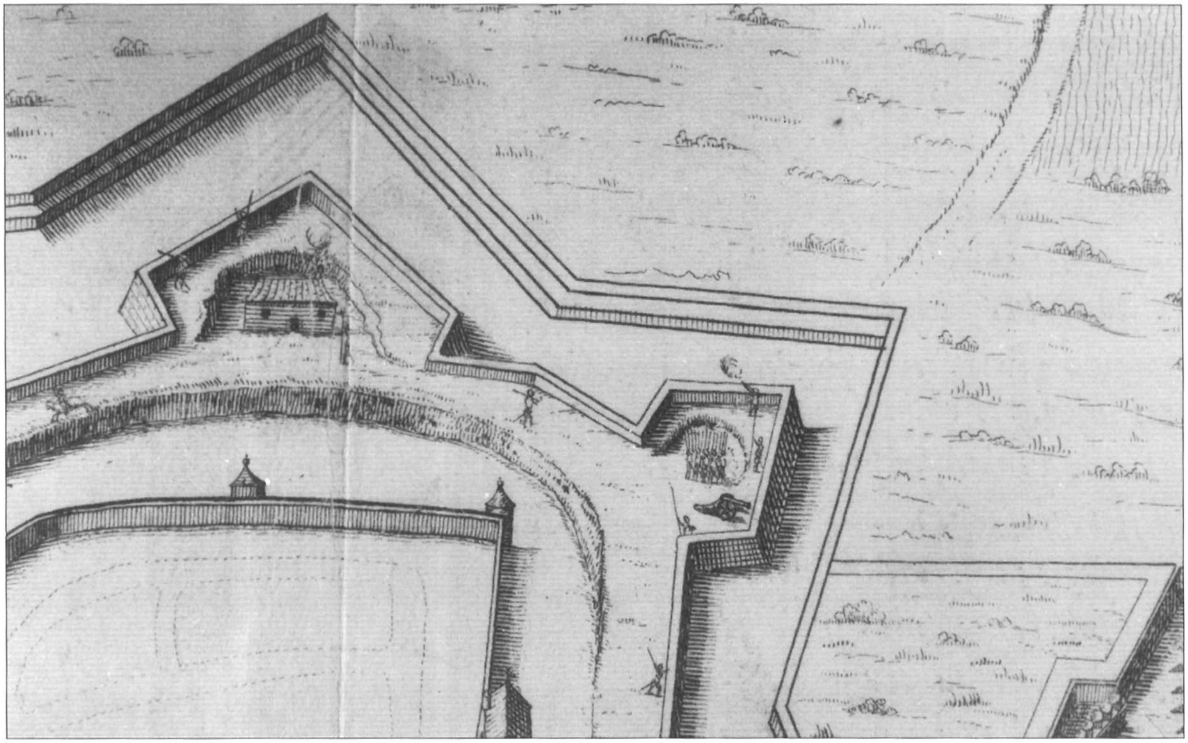


(REPRODUCED FROM "MODERN FORTIFICATION" OR "ELEMENTS OF MILITARY ARCHITECTURE" BY SIR JONAS MOORE 1673.)

size it was shaped with a strickle board to gain the desired shape. The strickle board was held against the side of the model, shaving off the clay as the model turned, until the right shape was achieved. Normally the model was extended at the muzzle end by about two feet to form the dead head. This is the part of the mould that would take the excess metal. It should be noted that the breech was not added until a later stage. Once the model was finished it was dried by heating and a thin layer of wax was applied to the surface to aid its later removal from the mould. Wooden models of the trunnions were then attached to the model, placed slightly nearer the muzzle than the breech. This gave preponderance to the breech and made controlling elevation easier. Finally, wax models of the decoration and dolphins were fitted. In most cases this was done by fixing a small mould to the model's surface and casting the item onto it. The moulds were then removed, leaving a wax model of the surface design. The whole model was now coated with more clay of a different type and diluted with water. Four or so coats of this clay were applied and then dried, and then larger quantities were applied to a thickness that depended on the type of gun: the larger the gun the thicker the mould. It is important to bear in mind that the gun barrel could weigh up to two tons and so the mould had to be able to withstand the weight of the molten metal. In order to guarantee this, the mould was bound with iron hoops to reinforce the clay.

Once the mould was bound, the model, or positive image of the gun barrel, had to be removed. This was done by removing the spindle with a mallet. As has been described, the spindle was covered with a rope wound around it that could be removed and the wooden patterns for the trunnions pushed into the mould and then removed. The rest of the clay

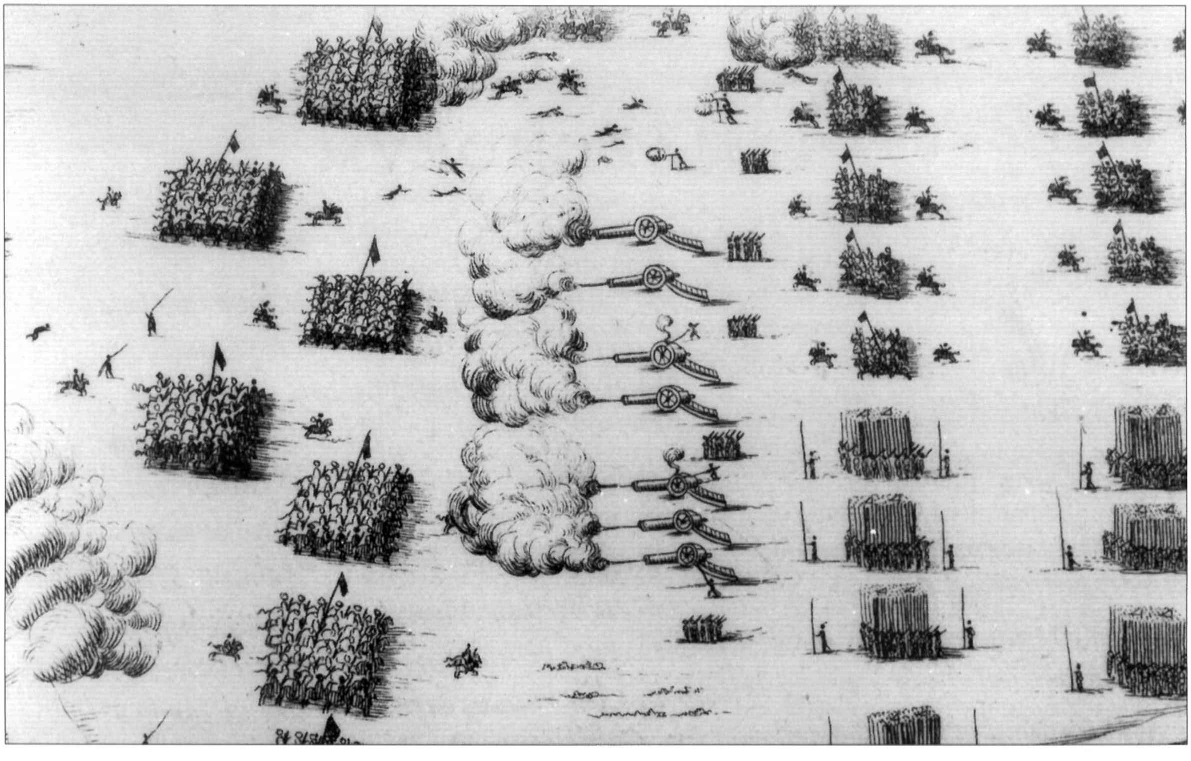
A typical 17th-century fortification with a bastion and outer wall. The gun is mounted to cover the lines of circumvallation that the besieging army has taken up.

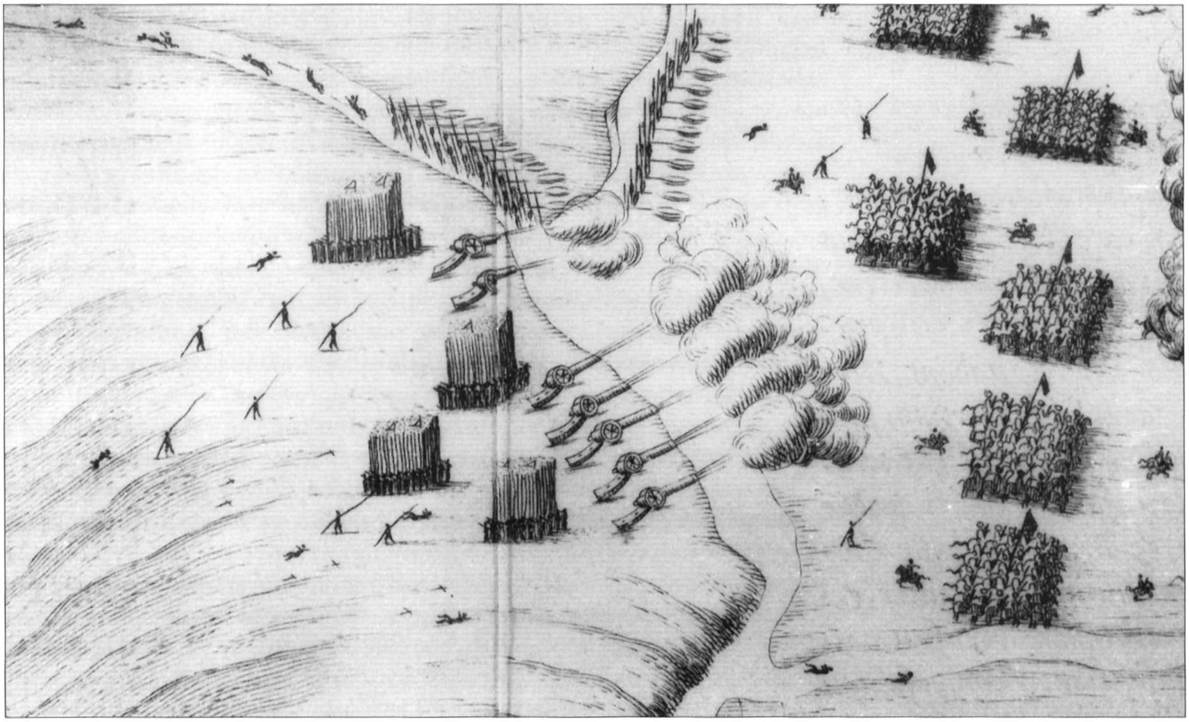


model now had no central support and began to collapse, leaving a negative impression on the mould itself. The mould was internally checked and any stubborn clay pieces were removed. In the end the mould would be a near-perfect negative replica of the gun. The breech mould was then attached at the end of the gun. This had to be made separately so that the spindle could be removed. In the 17th century all guns were cast using a central core. This was an iron spindle, which was covered in clay and horsehair. The core was eventually to form the bore of the gun. The final layer of clay was applied and a strickle board or shaper was used to replicate the calibre of the bore of the gun. If the gun was a perrier (a gun that fired stone projectiles), the bore needed to be shaped at the end and therefore the core was shaped to represent this. Chaplets, iron rings with four radiating arms, were used to secure the core at the top and bottom of the mould in the central position of the bore. It was critical to the use of the gun that the bore axis was parallel to the axis of the gun. If it was off-centre this rendered the gun useless although some defective guns were still used in spite of this. Sometimes chaplets were fixed into the breech mould but many were fixed into the bottom of the main mould. At the muzzle end a similar device held the core. It is still possible to see chaplets in existing bronze guns of the 17th century. If one looks at the surface near the breech end one may be able to detect a small, corroded iron slot. This is the end of one of the four arms: the chaplets, being sacrificial, were cast into the bronze body of the gun.

During casting, the moulds were placed upright in a pit and then earth was built up around them. Channels were created at ground level to let the molten metal from the furnace flow to the heads of the moulds.

Armies facing each other in the field. The guns are drawn forward of the main battle line where it is likely that the heavier ones would have been placed. From a French manual of 1635.





From the same source as the previous photograph but this time the guns are placed behind a natural defensive feature and appear to be firing over the heads of the advancing cavalry.

The tapping of the furnace and the filling of the moulds were the culmination of the process and it was common for dignitaries to be invited to see the process. Once the moulds had cooled it remained to dig them out of the pit and actually break them open to get at the cast guns. The core of each still had to be removed and, because a clay lining surrounded this, it could be loosened and gradually removed. The gun was then subjected to a cleaning-up process that included cutting off the dead head. This large extension to the muzzle had to be sawn off by several men using a simple hand-held saw. The bore itself had to be bored out to ensure that it was true and that no burrs or projections would cause problems with firing. A vertical, horse-powered, boring machine normally carried this out. The amount of metal to be removed from the bore was only the windage or the gap calculated to be required between the shot and the wall of the barrel. This gap was normally about a quarter of an inch and if the gun was bronze this required relatively little power. The gun barrel was suspended inside a wooden tower by means of a pulley and the chase and breech were clamped into a movable frame. Beneath the muzzle of the gun was a cutting tool on an axle. The axle was rotated by a horse pushing a beam at right angles to the axle and the gun barrel was lowered onto the cutting head. Any flexing of the axle or misalignment of the tool could ruin the gun, so it was essential that the person conducting the operation was extremely careful.

Once the gun was bored and finished it needed to be proved. This normally consisted of firing it with a large charge of powder and perhaps a round shot. According to Nathaniel Nye in *The Art of Gunnery*:

> All peeces that shoot a bullet under 10 pound weight and duly fortified with metal, being shot 3 times, first with the whole weight

of the iron bullet. Secondly with 5/4 parts thereof and lastly with 3/2 parts of the same will hold for any service, being charged with her ordinary charge, albeit the said peece were discharged 100 times per day.

GUN TYPES

The terminology of guns in the 17th century can be very confusing and so it is worth trying to explain here the logic in use at the time. Before 1716, when gun calibres became standardized, they were often known by the names of animals or birds of prey. Although theorists and gunners wanted guns to be standardized they very seldom were and so these categories could only ever be used in a broad sense.

The following table gives the lengths of the guns and their calibres according to three contemporary authors, William Eldred, Robert Norton and Nathaniel Nye. Eldred was the Master Gunner of Dover Castle and had experimented heavily with ordnance during his career. Robert Norton was a gunner in the Tower of London who basically adapted and translated more prominent European authors.

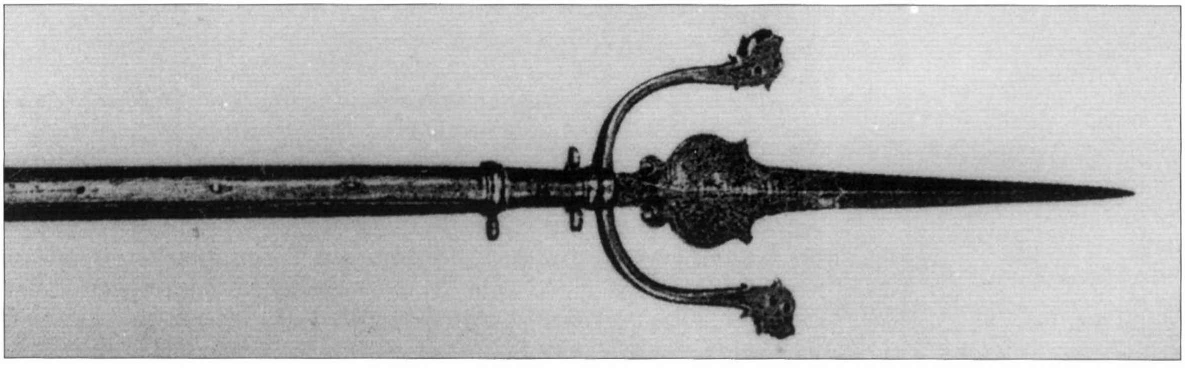
Type	Calibre (in)	Length of gun (ft)	Weight of piece (lb)	Author	Date
Cannon Perrier	12	8	3500	Robert Norton	1643
Cannon of 8	8	10	8000	Robert Norton	1643
				Nathaniel Nye	1647
Cannon 7	7	9.33	7000	Robert Norton	1643
Demi-cannon	6.5	9.75	6000	Robert Norton	1643
			5600	Nathaniel Nye	1647
			6000	William Eldred	1646
Demi-cannon drake	6.5	8.6	3000	Robert Norton	1643
Culverin	5.5	13.6	4500	Robert Norton	1643
			4000	William Eldred	1646
			4500	Nathaniel Nye	1647
Culverin drake	5.5	7.33	2000	Robert Norton	1643
Demi-culverin	4.5	12	2500	Robert Norton	1643
Demi-culverin drake	4.5	6	1500	Robert Norton	1643
Saker	3.5	10.5	1500	Robert Norton	1643
Saker Drake	3.5	5.25	1200	Robert Norton	1643
Minion	3.25	8.125	1200	Robert Norton	1643
Falcon	2.75	9.6	700	Robert Norton	1643
Falconet	2.25	9	500	Robert Norton	1643
Robinet	1.5	3	120	William Eldred	1646
Base	1.25	4.5	200	Nathaniel Nye	1647

It is obvious from the table that there was a bewildering variety of ordnance in use and that the technical authors of the day only agreed in part on lengths and sizes. Generally, guns can be put into two categories: the battering types and the culverin types. Those that were used for battering, or siege guns, were the likes of the cannon, demi-cannon and sometimes the perrier. The perrier was normally a large gun with a smaller bore powder chamber, intended to fire stone shot. The second category was that of the culverin, which was normally used to fire a lighter shot and had a theoretically longer range. Guns such as the culverin, saker and falcon might fit into this category. Culverin itself refers to a specific type of gun but also to a group of guns of similar type. There are two other terms that merit some explanation and, unfortunately, complicate the categorization of guns a little further. The terms are drake and bastard. The drake was a term which seemed to indicate a weapon lighter and shorter than the typical description of a type of gun; so a culverin drake might be shorter and lighter than a standard culverin. Why the gun was not just re-categorized is not known. Drakes are also often referred to as light guns of about 3-pounder calibre and Sir Edward Cecil brought ten of these guns to England in 1625. These guns were meant to fire 70 musket shot according to Cecil and this would reinforce the idea that smaller guns tended to fire more grape than round shot. Bastard was a term used to describe a gun that had the calibre and weight of a certain category but often did not comply in length. Clearly the authors of these descriptions were not in agreement themselves so it is often difficult to describe them with accuracy. Other such guns in use at the time were the minion, which had a bore of around 3¼in, and the fowler, which was a breech-loading iron gun often used on board ship.

Even so there were anomalies such as the basilisk, which were still in use in this period. The great Dutch gun known as 'Queen Elizabeth's pocket pistol', now on show at Dover Castle, is an example of a basilisk. It is a staggering 23ft in length and was presented to Henry VIII by Maximiliaan, Count of Buren, in 1545. It was used by William Eldred, the Master Gunner at Dover Castle, and was used in the Parliamentary artillery train, which was captured at Lostwithiel in August 1644.

There were many other types of guns whose names belonged to an earlier period of artillery but which still existed in this period, examples being the base, a gun that could be breech-loading and be made of brass or iron, and the port piece. A port piece was a breech-loading wrought iron piece normally used to fire stone shot. A murderer could again be a breech-loading gun firing small stone shot or lots of stones.

The mortar was the siege weapon *par excellence.* If the cannon was used to batter down the walls of a town it was the mortar that was used to harass inhabitants and set fire to the internal buildings. It could be used to throw explosive shells, incendiary devices and even showers of small stones into a town, with corresponding results. The mortar was normally cast from



A highly decorated linstock from the collection of the Royal Armouries. The two quillons left and right have been adapted to take a burning match. Each one has a screwed head which, when turned, pulls the jaws together, clamping the match. The linstock could be used to ignite the gun directly or could be placed away from the gun and used to light portfires. (Courtesy of the Trustees of the Royal Armouries)

brass and was so designed that its powder chamber was of a smaller diameter than the bore of the weapon. Existing weapons in the Tower of London tend to have bore diameters of 18 inches but obviously mortars could be larger or smaller depending upon their use. They could also be cast with their trunnions at the mid-point of the gun or at one end. Originally this may have been because mortars were expected to fire over a wide range of angles of elevation. Eventually, when they became universally used to fire at elevations over 45 degrees, the trunnions were normally fitted to the base of the breech. Existing mortars seem mostly to have had trunnions in the middle in the 17th century. The mortar's key advantage was that it could fire on a high trajectory and was therefore an indirect fire weapon, used to fire projectiles high over a town or castle wall to explode among the buildings behind.

During the period in which we are interested there were no standing artillery units. The Board of Ordnance, the body responsible for the supply and upkeep of military stores, provided guns and munitions to the army and navy. Its head was known as the Master of the Ordnance and he presided over a number of storehouses and foundries, which belonged to the King. Probably the most famous of these stores was the Tower of London, which still had a foundry on Charles I's accession. There were also arsenals at Upnor Castle, Portsmouth and Chatham. Hull was also an important magazine and port. This was to have very great significance for both sides, since the easiest way of transporting guns and munitions around the country was by the use of ships. Guns were normally manufactured by private foundries and there was always tension between the need for the monarchy to keep control of the industry and for the industry to export guns to make profit. Under Charles I export was permitted but it was heavily licensed.

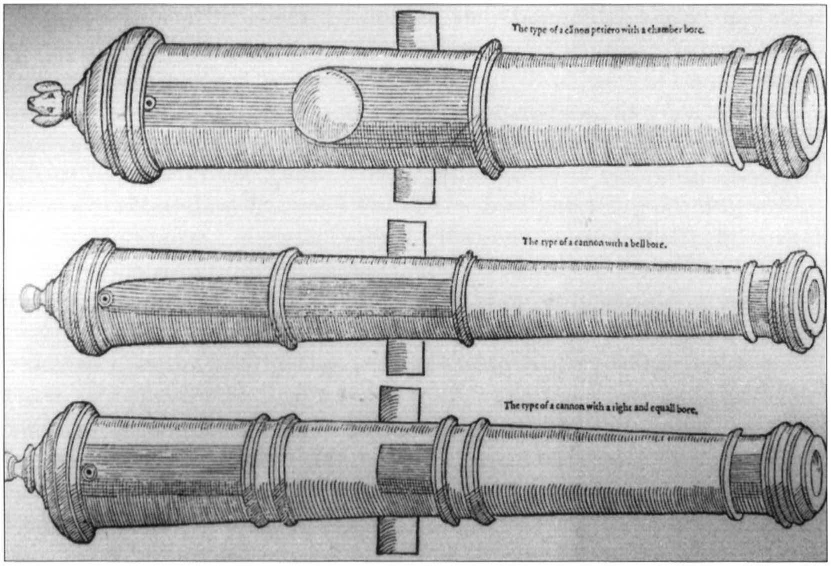
Inventories still exist for the Tower of London and they give us a good idea of the kind of ordnance stored there just prior to the Civil War. The inventory of the Tower of London for 1635 lists, for example, brass and iron guns of all calibres and all sorts of other equipment. There are many interesting comments made upon the state of some of the equipment, for example: 'Brass ordnance mounted upon field carriages with unshod wheels whereof 3 carriages decayed and 1 utterly unserviceable.'

In terms of guns listed there were:

On the White Tower
14 bastard demi culverins
1 saker

In the upper ordnance house
8 falconets of Jeremias making [Jeremia could be the manufacturer or designer]
1 brass mortar

On Tower Wharf
2 bronze bastard cannons
5 bronze demi-cannons
6 sakers of brass
1 minion of brass
3 demi-cannon drakes of iron


The type of a cãnon petiero with a chamber bore.
The type of a cannon with a bell bore.
The type of a cannon with a right and equall bore.

From *The Art of Shooting Great Ordnance* by William Bourne, published in 1583. Three different types of gun bore are shown. The upper gun is a perrier with a chambered bore. The middle gun has a bell or conical bore. The difference between a culverin (upper) and a cannon is obvious in that the cannon is a much weightier, heavier gun and the culverin is long and slender. The *Petriero a braga* was an Italian name for a bronze breech-loading gun with an iron chamber and tiller widely in use in the 16th and 17th centuries.

1 culverin of iron
11 demi-culverins of iron
45 sakers of iron
8 minions of iron

Upon the Green Hill in the Tower
2 brass cannons of brass on field carriages
14 brass falcons
3 brass falconets
1 brass robinet
1 saker drake of iron
4 forged iron murderers

In the long ordnance house
4 cannons of 8
1 cannon of 7
4 demi-cannon
1 bastard demi-cannon
3 culverins
4 demi-culverins
8 bastard minions
1 port piece and 1 fowler

In the Long Ordnance House
6 brass mortars
1 three barrelled brass gun
1 seven barrelled brass gun
12 iron murderers
2 brass bases
6 iron bases

Before the Byward gate
1 brass cannon

In the inner store house of the Minorits
4 brass drakes

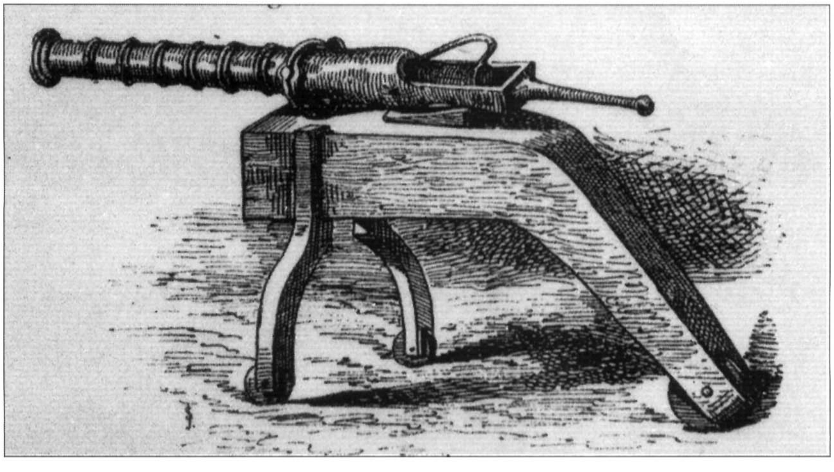
At the Artillery Garden
2 Brass cannon of 7 inches
2 brass demi-cannon
4 brass culverins
1 culverin drake
2 falcons
1 falconet of brass

This is a total of 190 guns and barrels, some mounted and some dismounted. It is interesting to note that quite a few older patterns of guns are listed, such as the base, murderer, fowler and port piece. By far the largest type of gun is the iron saker and if we divide the larger cannon type of gun from the rest of the group, only 26 are of the cannon or demi-cannon family. In contrast to the guns that were available at the Tower of London, a list of Ordnance taken from Hull in 1642 consisted of:

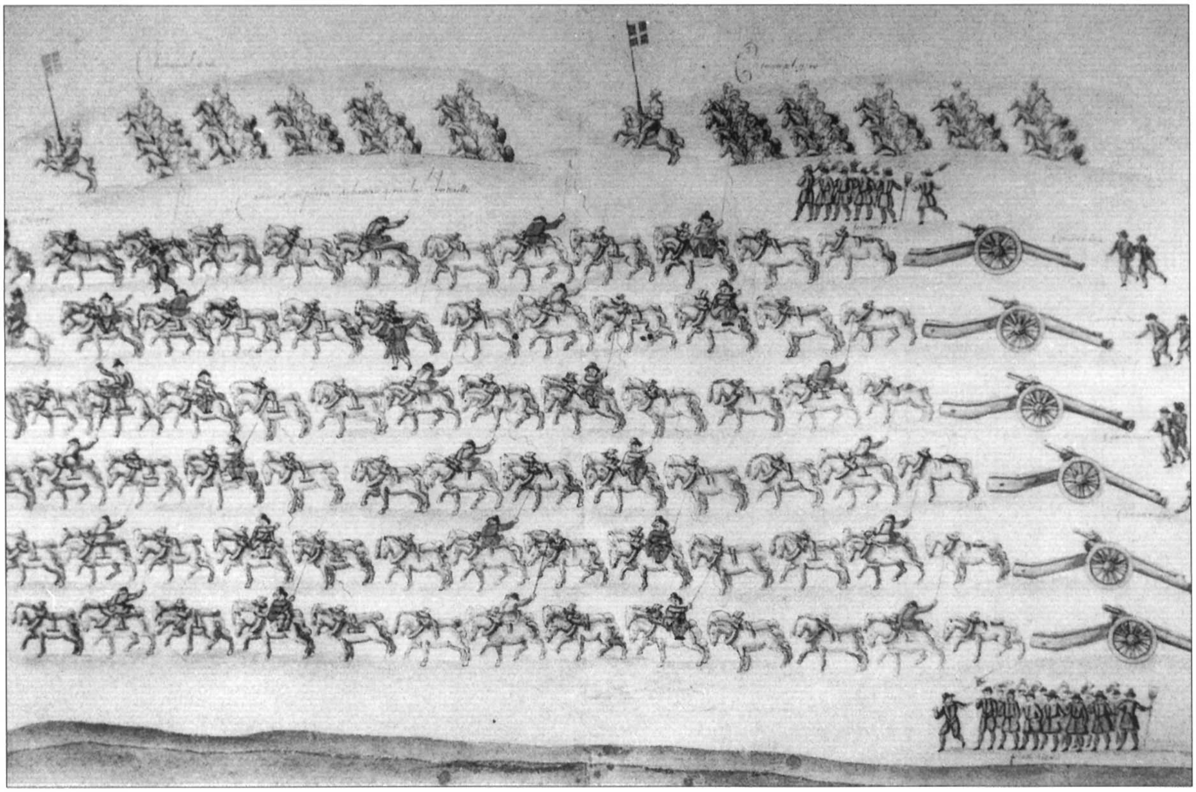
49 brass pieces
40 carriage with shod wheels
906 barrels of powder
1170 great cannon shot
1066 other cannon shot
118 ladles, sponges and worms
1 mortar piece
105 grenadoes (grenades or explosive shell)

CARRIAGES

Any large field gun carriage was composed of several components that were virtually standard in all European armies. The three largest elements were the two cheeks and the axletree. The axletree was normally of oak although it could have been made of other materials. Elm was widely used, but any hardwood could be pressed into service if required. It was normally



A stylized view of a wrought iron gun on a land service carriage. Iron versions of this kind of carriage still exist and are likely to have been used for fortress defence.



of square section with two shaped axles at its ends. It was bound with iron axletree hoops to resist the shock of travelling. The cheeks were long shaped pieces of wood that formed the two sides of the gun carriage. They were effectively formed of a square shaped fore end and consisted of two angled reverses on the wood making them look something like a crooked S shape in elevation. William Eldred, the Master Gunner at Dover Castle, wrote detailed descriptions of the composition of gun carriage parts. The common length of the cheeks was measured to 24 calibres of the gun, so for a cannon of 7 inch calibre they would be 14ft long. These two large pieces of wood sat on the axletree but were joined by three other transoms. The end nearer the muzzle is called the head by Eldred, and he calls the extremity of the other end of the cheeks the tayle. The lower transom joined the cheeks on the ground and was a flat board, pierced by a hole and often bound in iron, that received the pintle of the limber. The second transom was positioned near the axletree but behind it and on this the quoin or elevating mechanism was placed. The third transom was the breast transom and joined the cheeks near the front of the carriage. In order to hold all of these parts together the carriage had to utilize iron bolts passing between the transom and the cheeks. Before the widespread use of threaded nuts, the bolt was cut at its end with an aperture through which a wedge-shaped forelock was forced against a washer and then against the wood. It was hammered until it could be forced no further into the hole and then bent over. The carriage was bound with what was called head and tayle plates. These plates were formed over the front end of the cheeks and at the trail end to give the carriage rigidity. The plates were generally nailed into the carriage.

Artillery transportation in the 17th century. Each gun is drawn by 25 horses and five men but interestingly no limber is drawn here. It may be that the artist was not aware of their use or that this image does not show an accurate depiction. (From *Diego Ufano*)

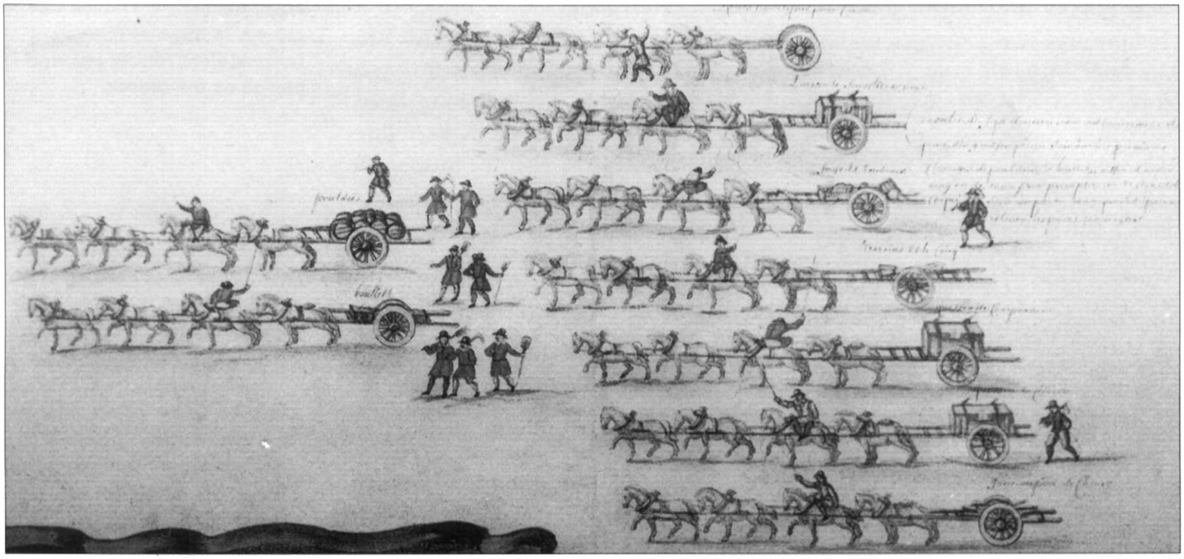
The table shown below details the suggested dimensions of Eldred's proportions for heavier guns. From his writings it seems that lighter guns required a more empirical approach to their construction. There are no existing complete field carriages in Britain from the period although there are contemporary models. Two early falconets exist in the Royal Artillery Museum in Woolwich in London and their carriages are thought to be originally 17th century, but they were extensively restored by the Royal Carriage Department in 1861 and therefore we cannot be sure to what extent they are original. Nevertheless, they do correspond to carriages in other European collections so their form appears to be correct.

Part	Culverin Breadth	Thickness	Length
Cheeks	4	1	24
Transom	1.5	1	not available
Tail transom	2	1	5
Middle transom	3 internal breadth	1	4
Head transom	2.5 internal breadth	1	3
Nave	3.5	3	not available
Spokes	not available	not available	3 overall 2 calibres showing
Axletree	not available	1.75	8.75
Axletree arms	not available	1	not available

All measurements in calibres, wheels to be half as high as the length of the piece.

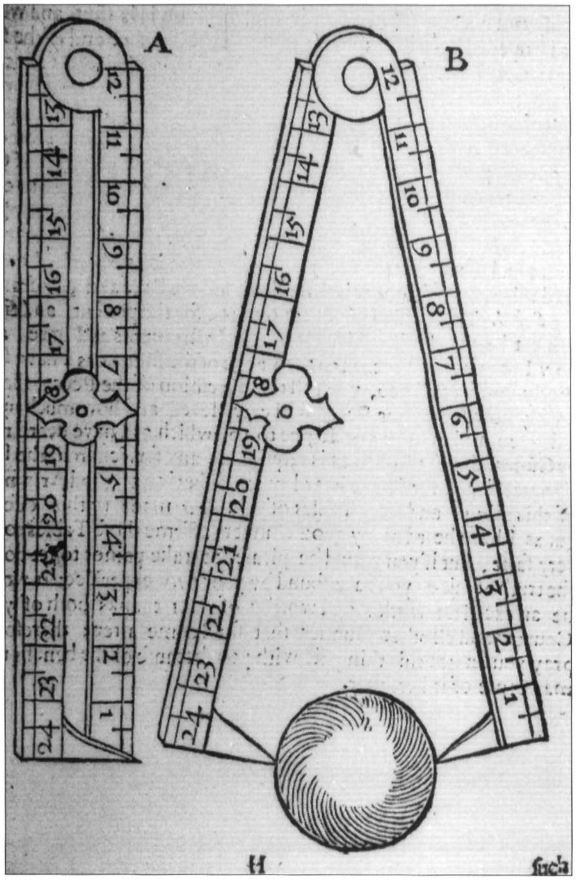
Wheels were dished to give them rigidity and to stop excessive forces acting on the stub axle. The stub axles were set at an angle so that each successive bottom spoke was perpendicular to the ground as it took the weight. This gives a splayed appearance to cartwheels, which have much more tapered, convex hubs at our period. The wheels were given strength by the addition of plates and pins outside the hub. The angle to the wheel at which the spokes were set seems to have varied depending on the maker. The wheels themselves were heavily built affairs with the hub often being more than 15 inches in diameter. The wheels consisted

Another image from *Diego Ufano*, showing carts and accoutrements used to accompany the guns. The upper carriage appears to be a two-wheeled vehicle with no upper works and may well be an early depiction of a limber.



of hubs (a large cylinder of wood in the centre of the wheel), spokes, felloes (the wooden parts of the outer rim of the wheel) and strakes (the metal parts on the outside edge of the wheel forming the tyre). Basically the hub held one end of the spoke and the felloes held the other. There were normally 12 spokes in a wheel. The strakes were nailed to the outside of the felloes, acting as a tyre and holding the wheel together. Some existing inventories state that unshod and shod wheels were stored. Whether this is an indication that the unshod carriages were used in the field is not clear. One of the earlier forms of gun carriage still in use in this period had the end of the axletree connected to the trail by a length of iron, presumably to strengthen the whole carriage.

Mortars tended to be mounted upon a bed. A static bed was used and often consisted of two side cheeks and two transoms all bound heavily in iron. The mortar could be equipped with a bolster or large shaped block of wood, which was placed under the chase of the weapon to adjust its angle of elevation.



From William Eldred's *The Gunner's Glasse*, this is an image of a measuring device and sighting rule. The object in the middle of the left leg of the rule could be adjusted up and down the centre with the legs closed. In this way it acted as a tangent sight for the gunner if placed on the breech.

LIGHT FIELD GUNS

The distinction that this author is making between light and heavy guns is a purely modern one but it is clear that the English Civil War saw the use of guns of position as well as their more mobile counterparts. It must be remembered that even a saker (5½ or 6 pound shot weight) on the field was a heavy object to lift or draw but culverins are recorded as having been used in the field. In reality a minion was probably the limit to that which could be moved quickly and safely around the battlefield by men alone.

One unusual example of light artillery was the leather gun. This was a copper or white iron tube wrapped around with rope and sewn into a leather case which could be transported very easily and would have been useful on campaigns where a heavy gun could not be used. A very fine example of such a gun exists in the Royal Artillery Museum in Woolwich and is complete with a prepared grape shot round. This gun may post-date the Civil War but it is of the same construction technique. Other examples can be seen in the collection of the National Museum of Scotland. The Parliamentarian General of Artillery James Weymiss was known to have introduced these guns into the army in the 1650s. The guns themselves were intended to be used sparingly because the main tube was not able to withstand repeated firings.

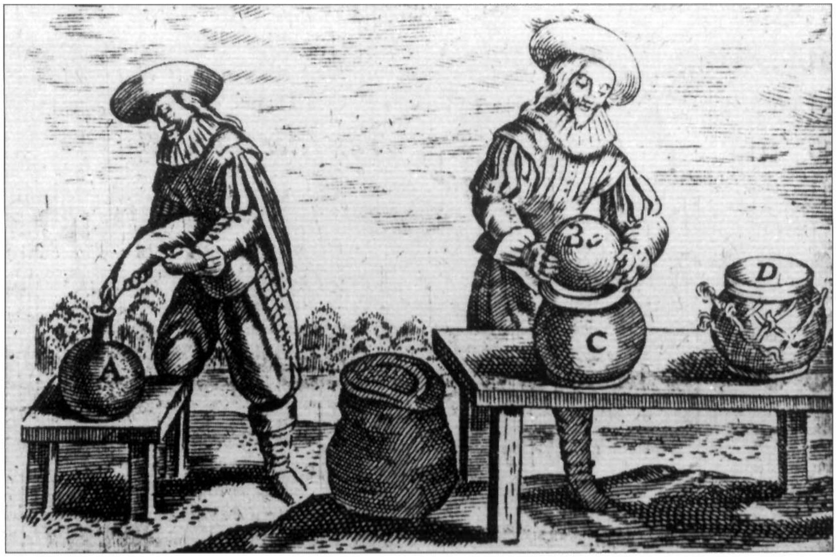
There was another type of light gun, much celebrated in Scottish circles, which was the frame gun designed by Sir Alexander Hamilton. The term 'frame' is quite confusing since many guns were mounted on frames and these could be used for fortress or field work. In Scottish terms the frame was a gun that consisted of a very short barrel, about 2½ft long and firing a 12lb shot, but in appearance looked almost like a howitzer of a later date and was mounted upon a light frame with two extended legs that terminated in solid wheels. Their contemporary description by the Royalists was as follows:

> Some short feeld pieces, of three foot longe or thereby, which for all that, were of ane indifferent wydeness, and did shoot ane in different great ball. Thes peeces wer the ordnar feeld peeces that afterwards for some tyme wer made use of, for the most part by the Covenanters ...
> (from John Spalding, *Memorialls of Troubles in Scotland 1624–45*)

The frame was intended to be carried on a mule and could be unloaded and fired quickly. But there are also many examples of guns that were mounted upon a frame-like carriage that were clearly positional weapons and were intended to be used inside fortifications.

By the 17th century it had become clear that one horse could draw a smaller gun barrel such as a 3-pounder and again the Swedes are credited with having introduced a simple one-horse carriage known as the galloper. Instead of having a solid trail, the gun was mounted on a platform which had two drawbars attached to its sides. The space in between was wide enough to harness a horse and act as the trail when the horse was removed. Contemporary illustrations show the metalwork and reinforcing to have been extensive, probably to reinforce the thinner drawbars. Actual references to these guns and how they were used is lost amongst the confusion of terms for light guns and inaccurate reporting.

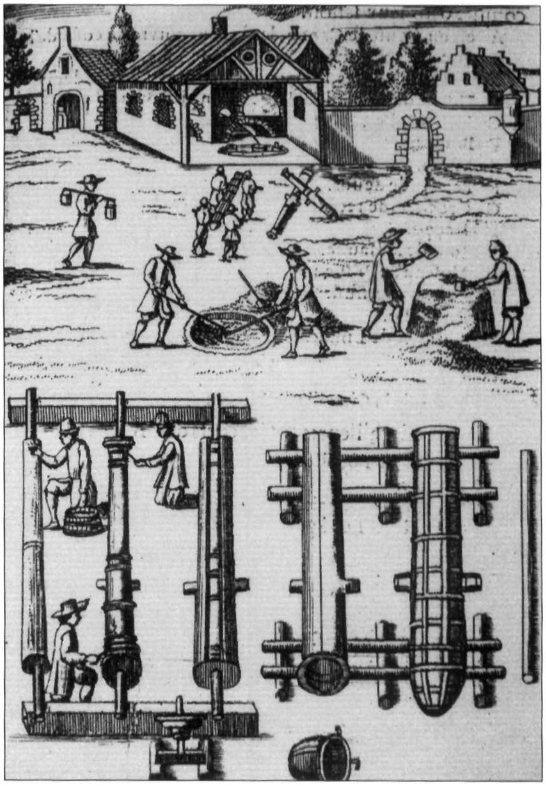
There were also many unusual and eccentric weapons that are hard to classify. For example, amongst the objects captured by the Royalists at Cropredy Bridge were 'two barricades drawn on wheels in each 7 small brass and leathern guns charged with grape shot' (quoted in C. H. Firth). These guns sound like a description of the organ gun or orgue which had been in existence for some time and of which there are many examples in museums in Europe.



Filling mortar shells and making carcasses. This 17th-century image shows the process by which hollow cast iron projectiles were filled with gunpowder. The figure on the left is making combustible projectiles that are fitted inside an earthenware pot. (From Manneson Mallet's *Les Travaux de Mars*)

NAVAL CARRIAGES

There are few existing gun carriages for this period that hail from naval vessels, but we are fortunate in that there is one known carriage that dates to the period and has been left virtually undisturbed in Windsor Castle since that time. It is thought to date to the 17th century and is of fairly simple construction. That this is a naval carriage is supported by the fact that documents exist detailing links between naval carriages and their use in fortifications. The carriage in this case consists of two cheeks and a flat bed resting on an axletree at the front and two chocks at the rear of the carriage. Two large iron bolts pass perpendicularly through the two cheeks and the cheeks are fixed directly to the flat bed. There are two large rings attached to the side of the bed and two smaller ones, probably for tackles, that fit into the side of the cheeks. These are probably for running the gun up to the gun port. Later manuals such as John Seller's *The Sea Gunner* show this kind of carriage in use in the 1690s but other similar carriages exist in Europe from as early as the 1590s. This carriage therefore may well be the standard naval pattern of the age.



An extremely interesting image from the latter part of the 17th century showing in the foreground the process for making the model of a gun. On the left is the core and in the centre of the three the model is made. On the right-hand side we see a mould and then the mould reinforced by iron bars. From Manneson Mallet's *Les Travaux de Mars*.

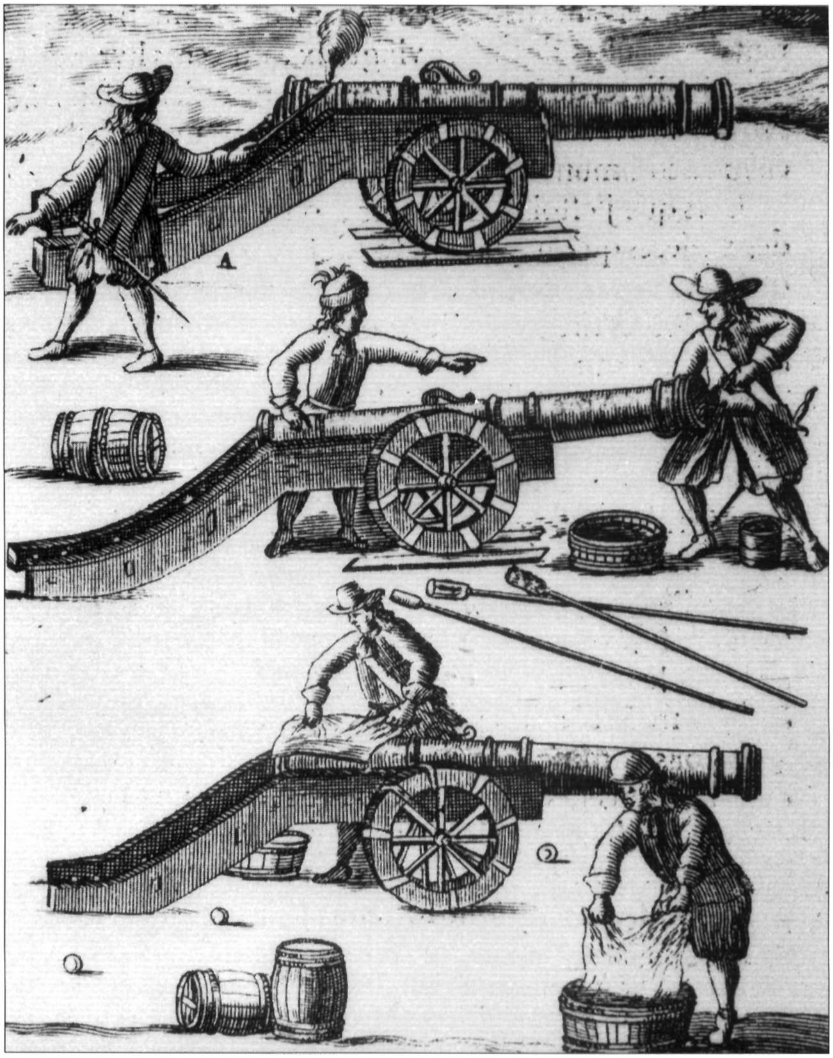
AMMUNITION AND TOOLS

Although the cast iron round shot was the commonest form of projectile in use during the 17th century, stone projectiles were in use as were those made from lead. There are even many examples of shot formed of a central iron cube but cast in lead. All of those projectiles were used at long range for siege work. The main problem during this period was that shot sizes tended to be non-standard so that ammunition made for one gun would not fit another. Several contemporary writers have written about the need for the gentleman gunner to check the size of shot prior to an engagement and then to place the shot in the correct pile so that they were easily discernible. It was also the custom to use smaller diameter shot and wrap them in a coating of lead or anything to hand should ammunition stocks become low. Shot was often cast in a small mould that was held by two long tongs and filled individually with molten iron.

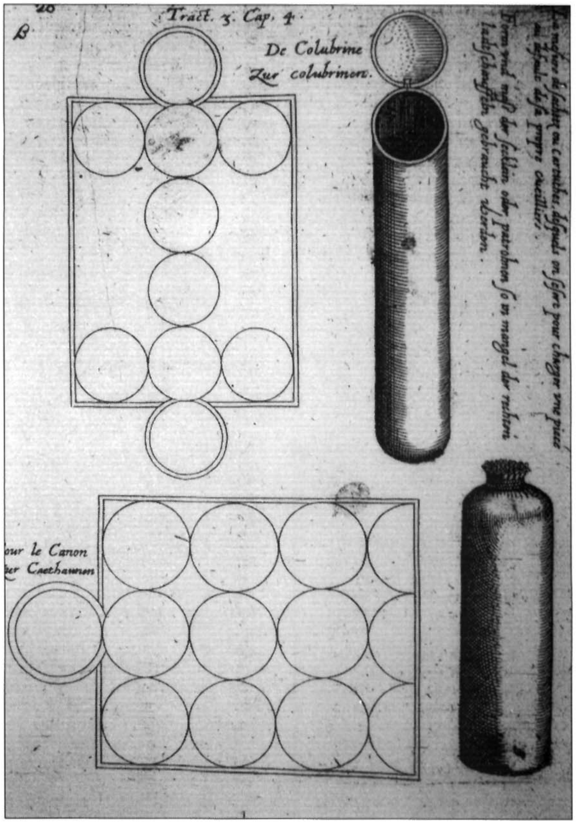
At closer ranges than 300 paces grape shot was used. This normally consisted of seven or eight small lead or iron pellets grouped around a wooden or iron core and then sewn into a canvas bag. When fired, the bag disintegrated and the shot were dispersed forming a sort of large shotgun-style cone of fire. This form of projectile was very effective at close range.

There were also hollow iron shot called grenades (or grenadoes), known more commonly in the later 18th century as shell. They were filled with gunpowder and used a wooden fuse or match to explode them after a time delay. During this period grenadoes were fired from mortars and it was a dangerous business since the gunners had to ignite the shell just before firing the propellant charge. It was known during this period that the flash of the mortar propellant would ignite the fuse but it rarely seems to have been relied on for this purpose. In addition to iron shells, naked earth and glass grenades are described by Robert Norton as being fired from mortars. They were fired with a greatly reduced charge, typically one-tenth of the normal powder charge.

Gunpowder was clearly of primary importance in a war where control of the magazines dictated the ability to prosecute a war. London was the centre of gunpowder distribution and production was controlled by a small group of manufacturers although laws introduced by the Crown to rectify this situation had little effect during the wars. Charles I used the services of William Baber in Oxford to convert a mill at Osney for gunpowder manufacture. In fact, the trend amongst the Royalists was to try to establish a mill where there was any large garrison. York and Newark are two good examples.



Guns being loaded and fired. Note the profusion of tools on the ground in the central scene. The nearest gun is having the breech cooled by applying a wet leather or sheepskin after firing many rounds.



Cartridge-making for guns. The cartridge was often made up of paper but was manufactured to a precise formula based on the calibre of the gun, here represented by circles drawn onto the paper. The upper image is a cartridge case for the cartridge designed in the same way.

On the Parliamentarian side the story was similar and mills were established at Colchester, Derby, Hereford, Ludlow, Nottingham, Shrewsbury and Worcester. What is clear is that gunpowder was manufactured where and when possible by all manner of means and this leads to the question of its quality. Quite clearly, hand-milled powder was often resorted to in times of emergency and soldiers scoured the land looking for saltpetre. The other two ingredients, charcoal and sulphur, were another matter. Charcoal was easy to get and manufacture but sulphur had to be imported and was expensive.

The amount of gunpowder used depended on the gun and the theorists are not clear on this. Nathaniel Nye states that a brass saker of 1,500 pounds weight would need 4lb of powder for the propellant charge. A demi-culverin weighing 2,800lb needed a 7½lb charge. There is also a question of whether corned powder or serpentine was used. Corned powder was a more powerful propellant that was mixed together wet then dried and sieved. Serpentine was a much older type, which meant that the ingredients were dry mixed. As we have seen, this might have affected the power of the powder but there was plenty of dry mixed powder around in the Civil War.

Incendiary devices were common during this period and could consist of iron, earthenware or even glass pots filled with a burning composition but normally fired from a mortar. The 1639 inventory of the Tower of London calls them ‘Powder Potes of Karth’. The description is as follows: ‘Earthen bottels to be made of a round fashion … half full of serpentine powder, or somewhat more, there is to be mixt with it a quantity of Hogges grease, Oyle of stone, Brimstone, saltpeter twice refined, Aqua vitae, pitch . . .’

As an example of how quantities of ammunition were considered for an artillery train we might consider that calculated for a train of 20 guns by James I, who was considering supporting his daughter Elizabeth of Bohemia in a campaign in 1620. It was calculated that

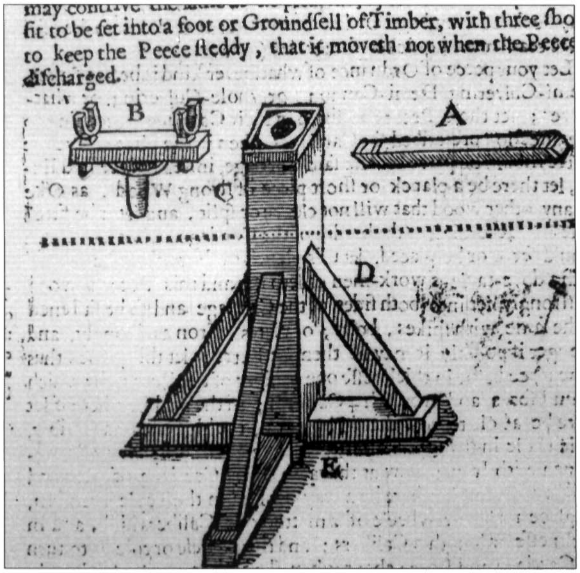
> The pouder for the use and service of the sayd twenty pieces of great ordnaunce (alowing nine hundered and sixty shot to every of the sayd peeces of batterye for ten dayes battery in six moneths, and three times as many to the six field peeces, will amount to one hundred thirtie eight lasts [the ‘last’ was a barrel containing the shot] (from a pamphlet entitled *Equipping a C17th Army*, by Evans).

There was a variety of tools to enable the gunner to perform his duties. They were known as side arms and were mostly long-handled tools that could reach down the bore of a gun. Along with the ladle and sponge, the most commonly used were as follows:

Budge barrel – a wooden gun powder barrel with a leather insert that was used to catch any loose powder.
Hand spikes – long staves of wood used to elevate the gun barrel and move the trail when aiming.
Ladle – a long stave with a copper scoop on the end used to handle loose gunpowder.
Linstock – a long stave with an iron head having two extended arms. These arms terminated in screwed clamps which held the burning match used to set off the powder train in the vent when firing.
Powder horn – to provide fine powder in the vent.
Pricker – a non-ferrous metal spike used to clear the vent or touch hole of the piece and to pierce the cartridge bag if it were used.
Quadrant – the indicator that showed the gunner how much his gun was elevated. The quadrant could also be combined with other instruments.
Rammer – a wooden stave with a cylindrical wooden head for ramming shot and charges down the bore of the gun.
Shot gauges – for measuring the size of shot.
Sponge – a stave with a sheepskin wrapped around a wooden head used for sponging the barrel with water, thus putting out any hot embers, and for cleaning the barrel.
Wads – rings or cylinders of oakum or straw placed between the gunpowder charge and the shot and to hold the shot in place if the barrel were depressed. Normally two wads were loaded per round.

Many gunners had their own specialist equipment and a gunner's stiletto was a common form of measuring device. It consisted of a dagger marked off with a scale for converting the diameter of the bore of the gun into the weight of shot required. Some combination instruments included a sight, a rule and a quadrant.

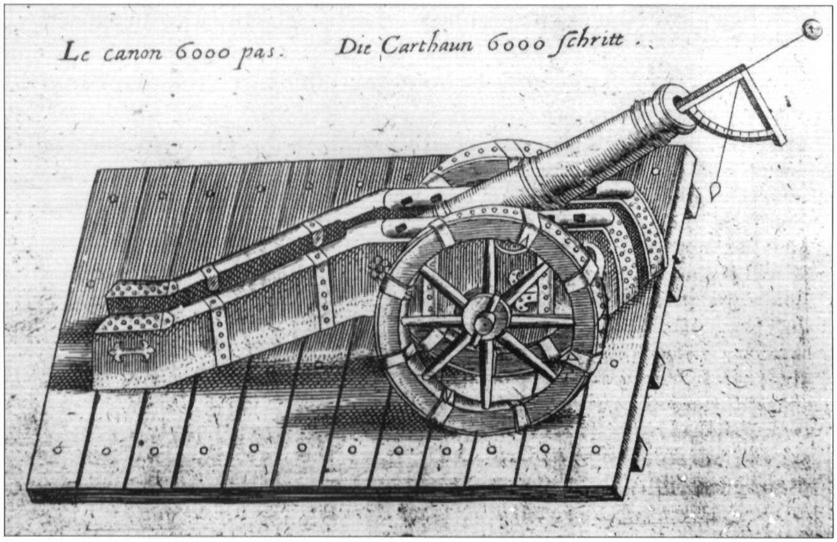
The mounting put forward by William Eldred for mounting a parapet gun. This image shows the component parts of the mounting.



fit to be ſet into a foot or Groundſell of Timber, with three ſho
to keep the Peece ſteddy, that it moveth not when the Peec
diſcharged.

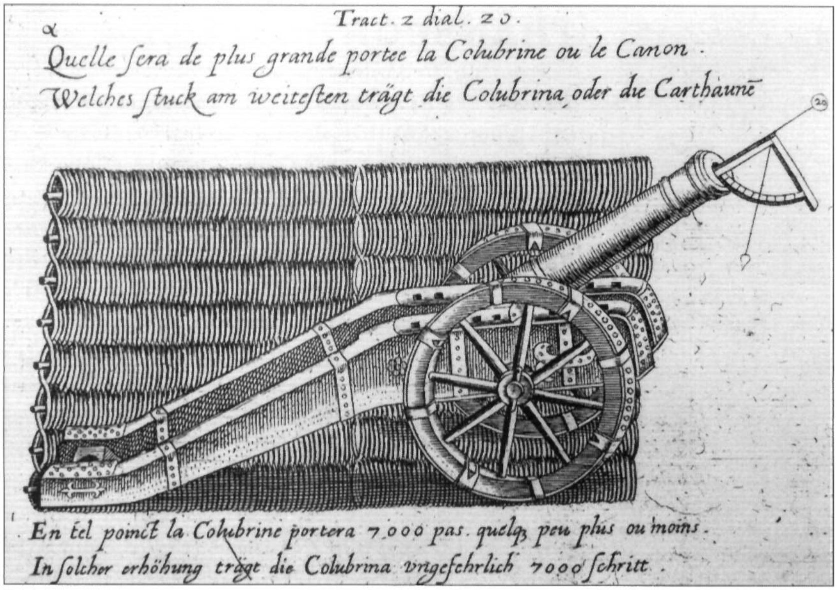
TRANSPORT

There were four main ways of getting a gun from one place to another during the English Civil War: horses, oxen, men and ships. The use of the first two was extremely significant to the prosecution of land battles and it has been said many times that artillery trains were the slowest part of the army. The combination of bad roads and heavy cumbrous transport meant that the artillery train was always the last to arrive anywhere. In order to pull it, horses or oxen were needed in great quantities, thus creating the logistical problem of feeding the animals. By the 17th century there were several techniques for transporting a gun and often the gun is seen in contemporary drawings being pulled by 20 or even 30 pairs of horses for a large gun. The gun carriage could be

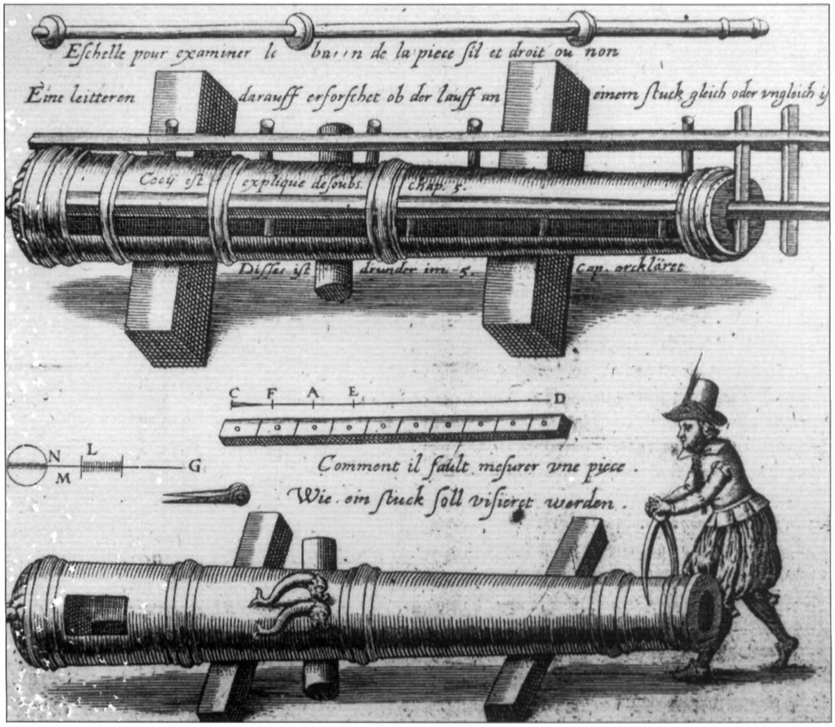

Le canon 6000 pas.
Die Carthaun 6000 ſchritt.

An illustration demonstrating the use of the gunner's quadrant for setting elevation. The gun was elevated until the plumb bob aligned with the required elevation setting. Note that the gun is positioned on a wooden platform. This was common practice when using guns of position; it prevented the gun carriage digging into solid ground and made traversing much easier. (From Robert Norton's *The Gunner*, 1628)

converted to a four-wheeled vehicle by adding a detachable limber to the trail of the gun carriage. Generally the limber consisted of an axletree with two smaller diameter wheels and a drawbar. The axletree had a pintle onto which the trail transom was hooked. Limbers are mentioned in inventories of the Tower of London as early as 1497 so they were in common use from that time. There are drawings that show the gun being pulled directly by horses with no limber at all. This may be due to artistic licence or to a lack of technical knowledge on the part of the artist, but it is also possible that some guns were pulled without limbers. The strain on the rear two horses of the team would have been very great and one wonders whether this was done out of necessity. For a large gun it was not uncommon to take the gun off its field carriage and transport it on a drug or four-wheeled carriage. This four-wheeled carriage was actually just a frame formed by two axletrees with connecting timbers


Tract. 2 dial. 20.
Quelle ſera de plus grande portee la Colubrine ou le Canon.
Welches ſtuck am weiteſten trägt die Colubrina oder die Carthaune
En tel poinct la Colubrine portera 7000 pas. quelq; peu plus ou moins.
In ſolcher erhöhung trägt die Colubrina vngefehrlich 7000 ſchritt.

Another image from Robert Norton but this time showing a culverin mounted upon a wicker platform.


Eſchelle pour examiner le baſſin de la piece ſil et droit ou non
Eine leitteren darauff erforſchet ob der lauff an einem ſtuck gleich oder vngleich iſ
Ceci est expliqué deſoubs. chap. 5.
Diſſes iſt drunder im 5. cap. erklärt
C
F
A
E
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L
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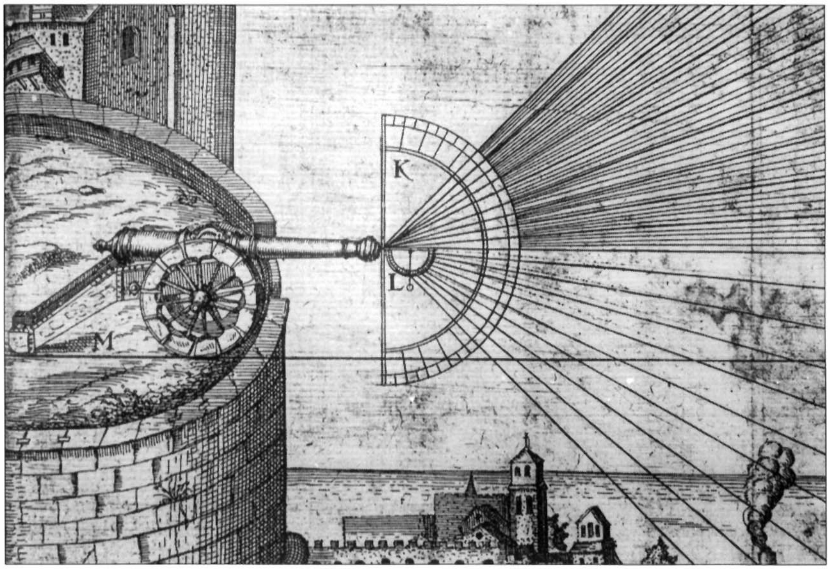
G
Comment il fault meſurer vne piece.
Wie. ein ſtuck ſoll viſieret werden.

A contrivance for measuring the bore of cannon. The figure in the lower part of the image is measuring the diameter of the chase. Many of these illustrations come from Robert Norton but were clearly used in other illustrated textbooks of earlier and later periods, hence their captions are often in French, German, Italian and Spanish.

upon which the barrel was laid. In order to get it on the field carriage a gyn or tripod-lifting stanchion was used.

Nathaniel Nye, in his 1670 treatise, covers the whole issue of pulling guns. He states: 'It is to be noted that 3 yoak of oxen [yoak, yoke or pair] are thought to draw as much as three horse, and that three yoak of oxen are sufficient to draw a saker of 1400 [pounds] weight.' For the very largest of guns, the cannon of 8,000lb weight, it was recommended that 34 oxen or 17 yoke could pull a cannon. If no oxen or horses were available then it was down to Shanks's pony and at least 90 men were needed to pull a cannon, according to Nye. Norton slightly differs by saying that 100 men could pull a demi-cannon of 6,000lb. Given that an ox was at least 6 feet in length with a small gap in between of say 2 feet per pair this would make the towing unit over 136 feet long. It is fair to say, therefore, that battering trains were certainly going to be slow and unwieldy when of this size. If several large guns were in the train, then the trains were going to be exceedingly lengthy. It is interesting to know that the great basilisk, 'Queen Elizabeth's pocket pistol', was an extremely long gun so the efforts taken to move it must have been particularly spectacular. It is a known fact that it became part of a Parliamentarian artillery train and no doubt a great number of personnel were used to get the gun from one point to another.

Many gun barrels were kept dismounted and were mounted only before a battle or siege. This mounting was normally carried out by the use of the gyn. This was a tripod, which was placed over the barrel, whereupon the dolphins were attached to a hook and tackle. A team of men then applied handspikes to notches cut in a spindle attached to two of the legs and the resulting mechanical advantage enabled the barrel to be lifted. In fact, where a gun was likely to need pulling uphill, pulleys



A theoretical image showing the arcs of fire possible for a gun mounted upon a tower. Clearly the theory was not sound in many cases. Gunnery was one of the evolving sciences of the 17th century but there was often a great discrepancy between what was known to happen in practice and what was written about in instructional texts.

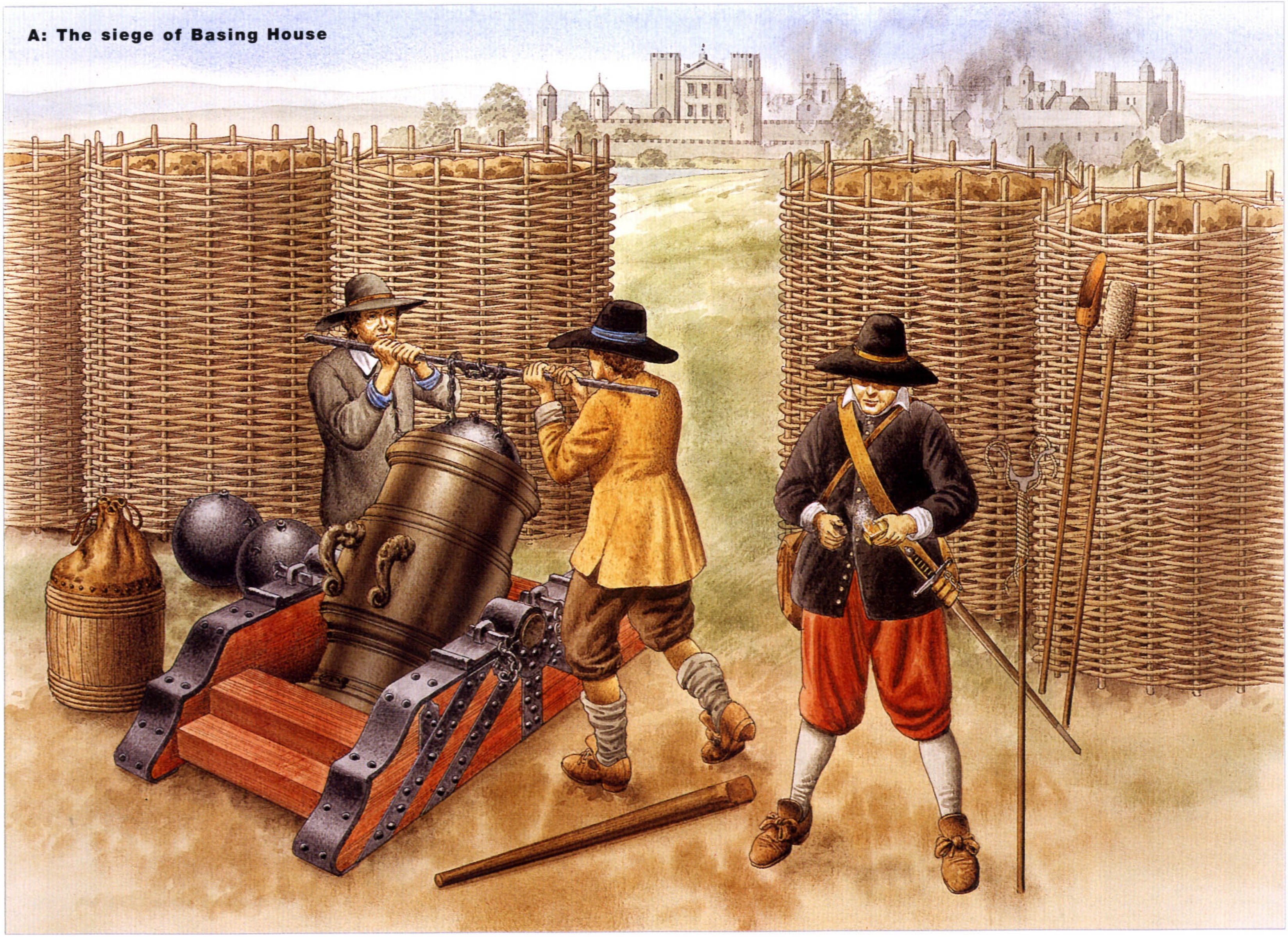
would be required to enable the gun to be hauled. Norton describes the process in his book by illustration, showing a pulley, placed at strategic places, which enabled the gun to be wound up the road when the horses or oxen were unable to carry out the task.

At the other end of the scale a falcon only required three horses and the smaller types of gun such as a robinet could be pulled, using drag ropes, by three men. Normally the guns would have breast rings and drag washers on the wheels to which ropes could be attached.

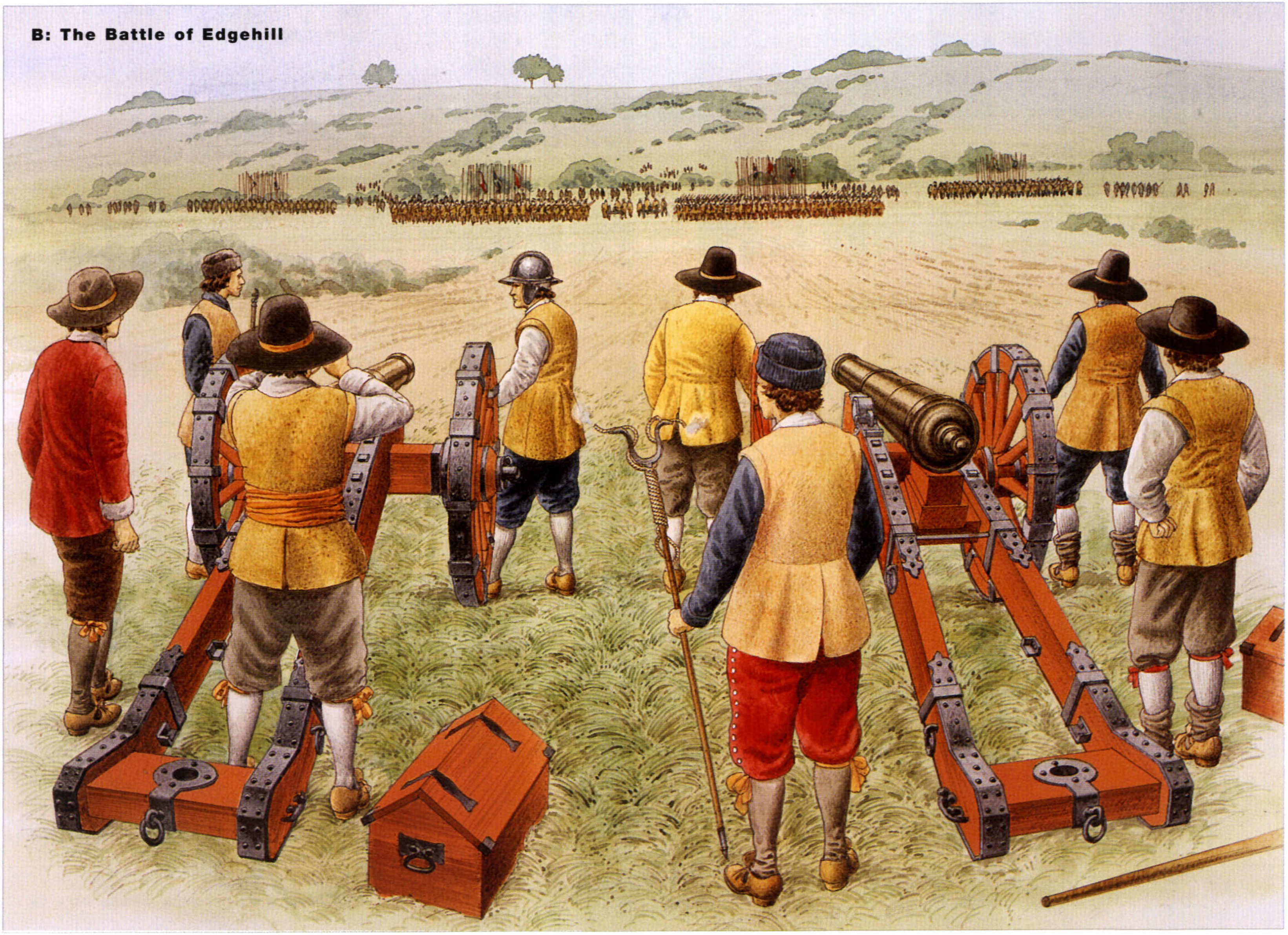
DRILL

Everybody in the 17th century seems to have had their version of drill and in many respects they differ only slightly. It is important to stress that the effects of gravity on a projectile and how that transferred from theory to practice were not understood widely. Manuals were available that described some of the theorems but this rarely replaced the good old eyeball Mark I. From practice and with common sense, gunners tended to know the way in which their guns reacted when elevated or depressed and, although instruments were used, commentators emphasized the need to rely on knowledge gained by experience. William Eldred was one such gunner. This particular version of drill comes from William Eldred's *The Gunner's Glasse* and consists of 13 different movements:

> Put back your peece – this meant moving the gun so that it was more or less level on the ground.
> Order your peece to load – the ladle was used to search the gun bore or check to see if there were any obstructions in the bore. The bore was then treated to the sponge in the same way.
> Search your peece – carried out using the ladle, according to the text: the worm, a coiled metal spiral on a long shaft, was in use in Europe at this time but Eldred explains this action as being carried out with the ladle.

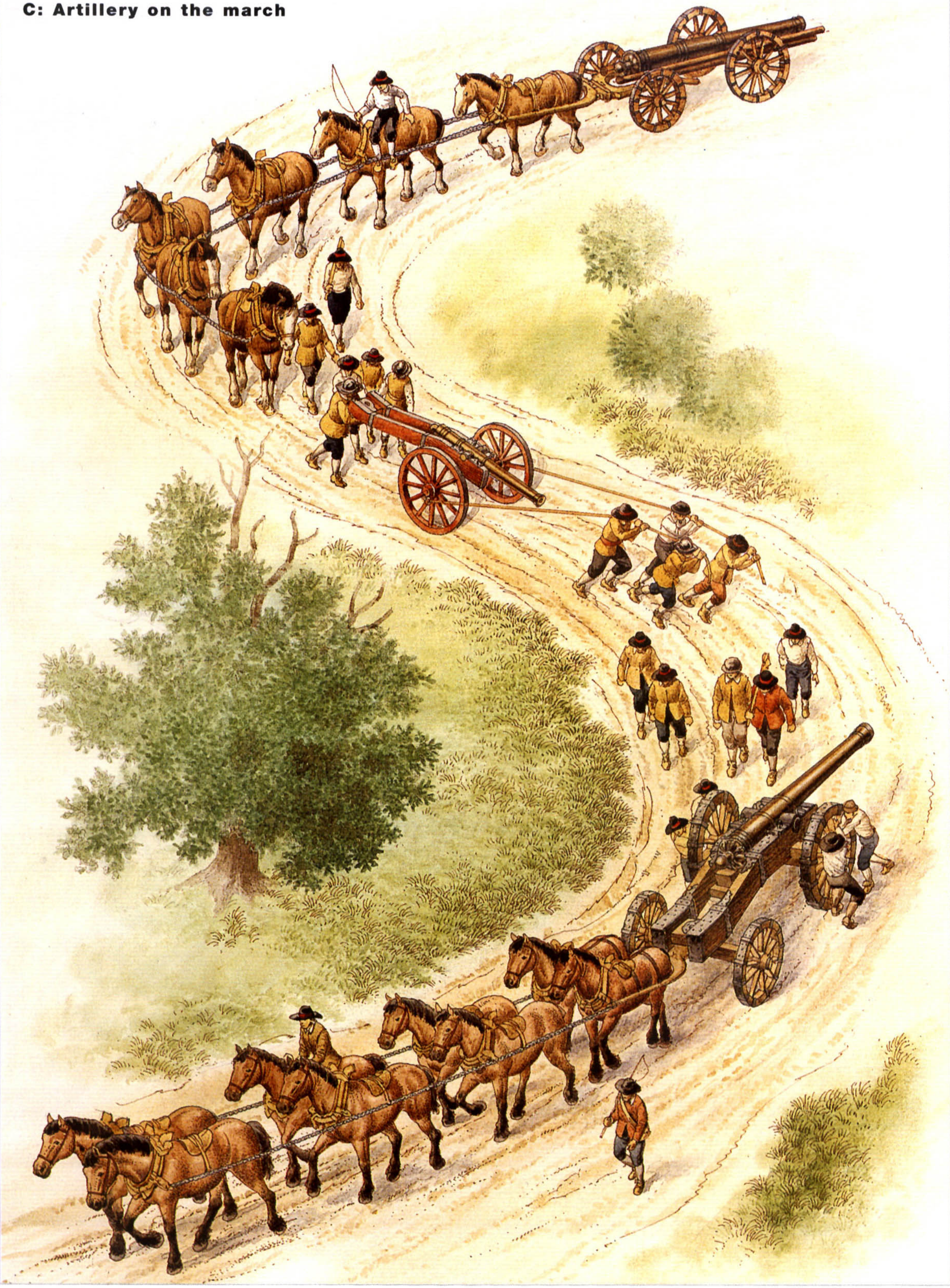


A: The siege of Basing House



B: The Battle of Edgehill

C: Artillery on the march



D: THE SAKER AND ITS COMPONENT PARTS

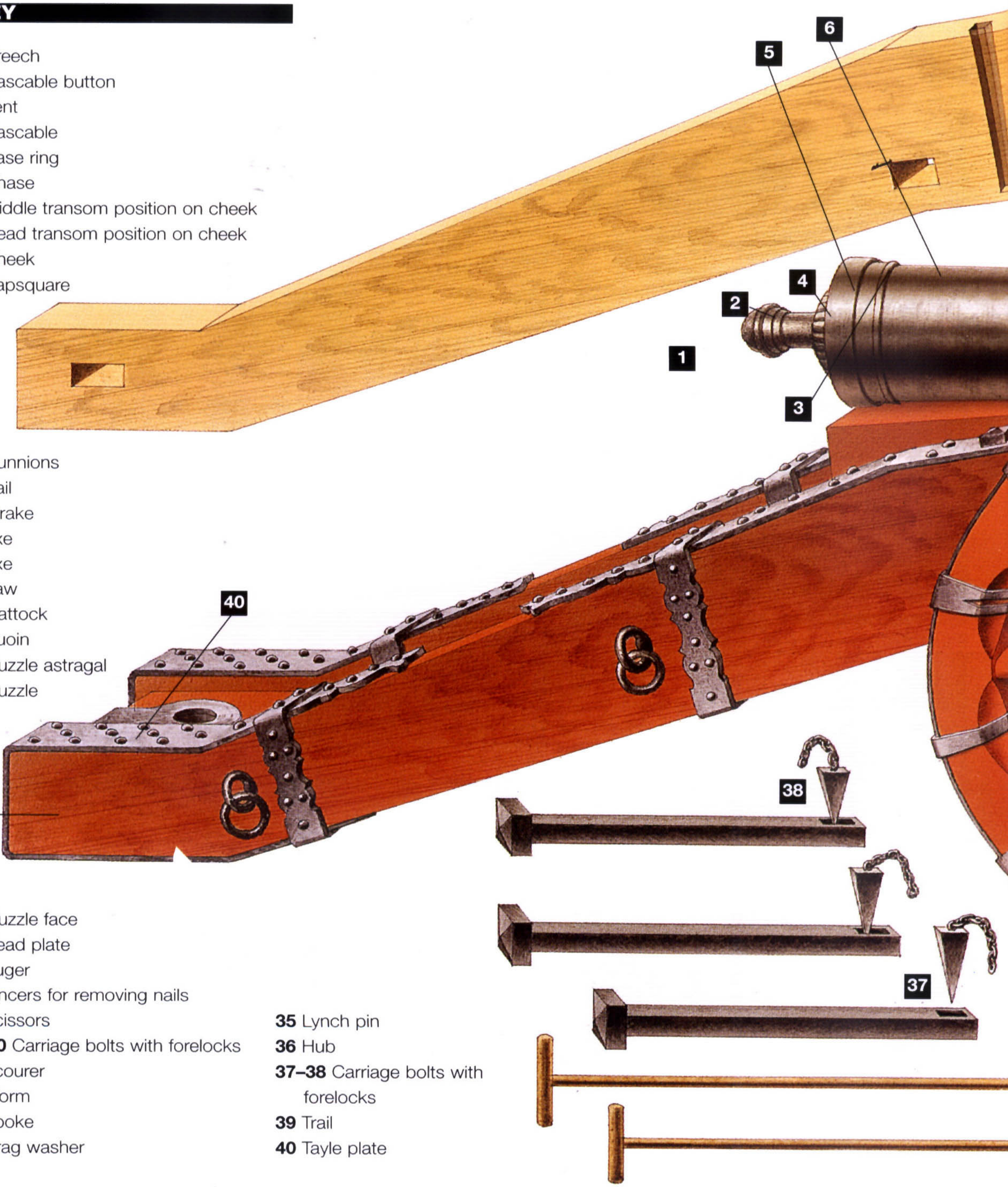
KEY

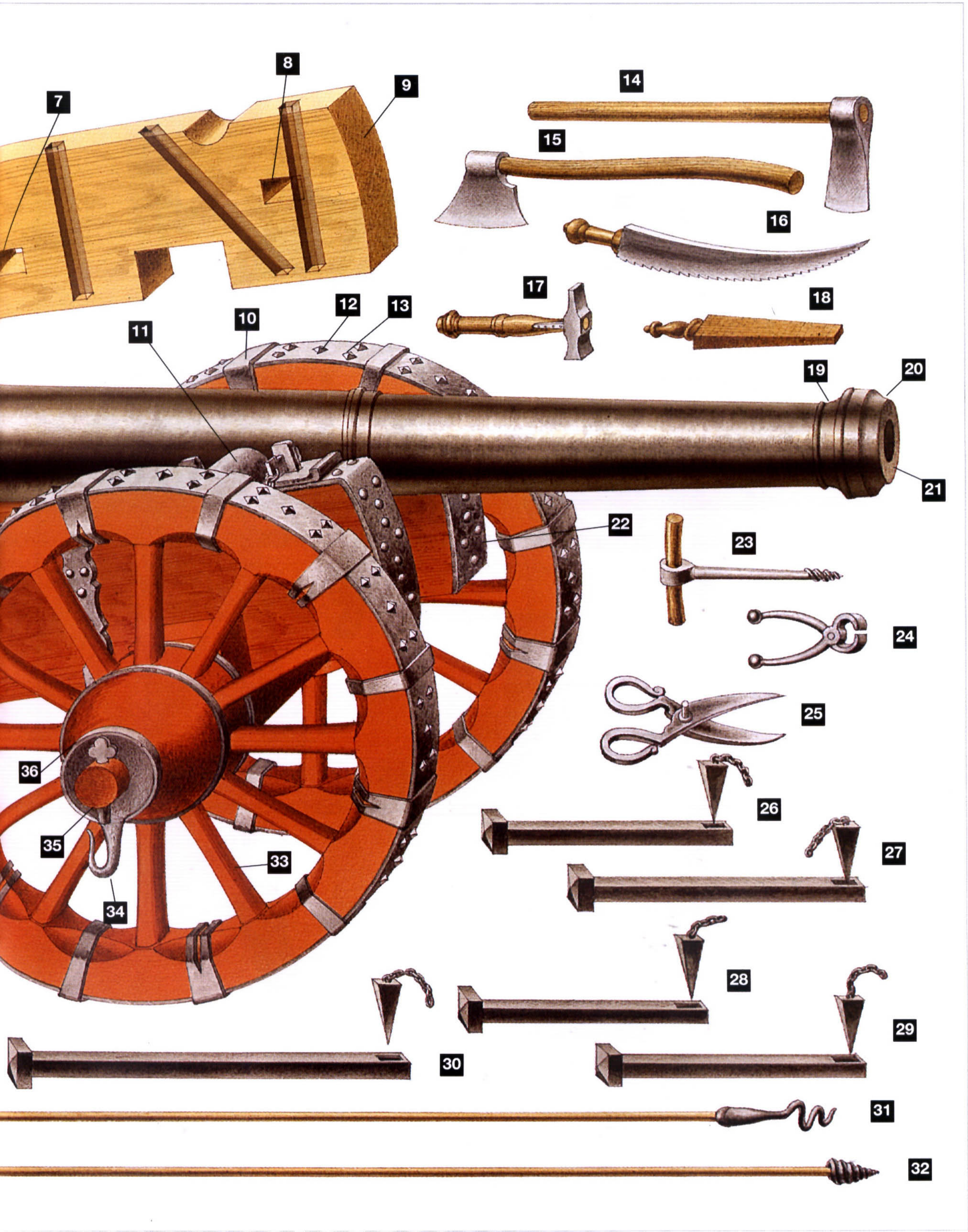
1 Breech
2 Cascable button
3 Vent
4 Cascable
5 Base ring
6 Chase
7 Middle transom position on cheek
8 Head transom position on cheek
9 Cheek
10 Capsquare

11 Trunnions
12 Nail
13 Strake
14 Axe
15 Axe
16 Saw
17 Mattock
18 Quoin
19 Muzzle astragal
20 Muzzle

21 Muzzle face
22 Head plate
23 Auger
24 Pincers for removing nails
25 Scissors
26–30 Carriage bolts with forelocks
31 Scourer
32 Worm
33 Spoke
34 Drag washer

35 Lynch pin
36 Hub
37–38 Carriage bolts with forelocks
39 Trail
40 Tayle plate

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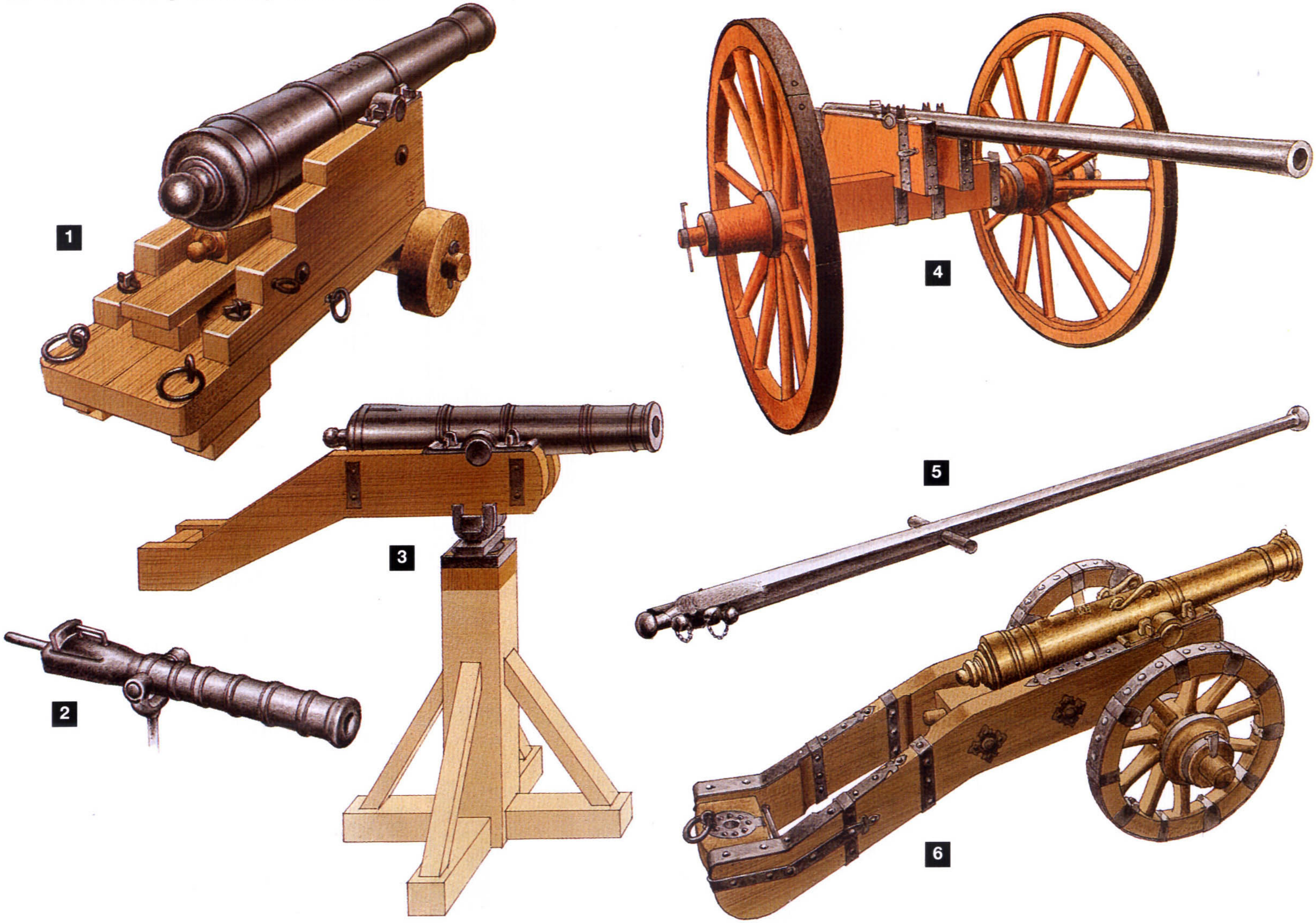
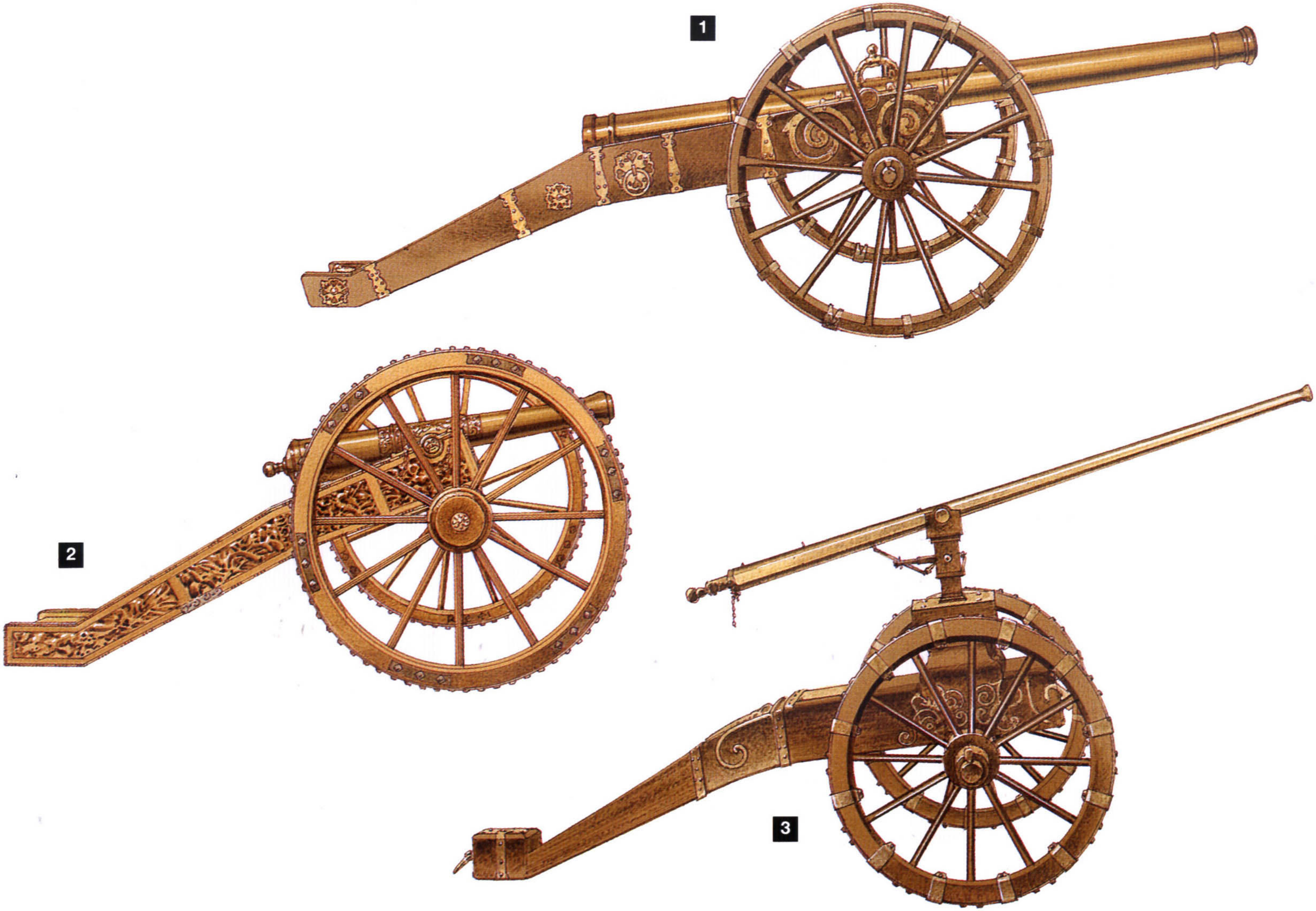
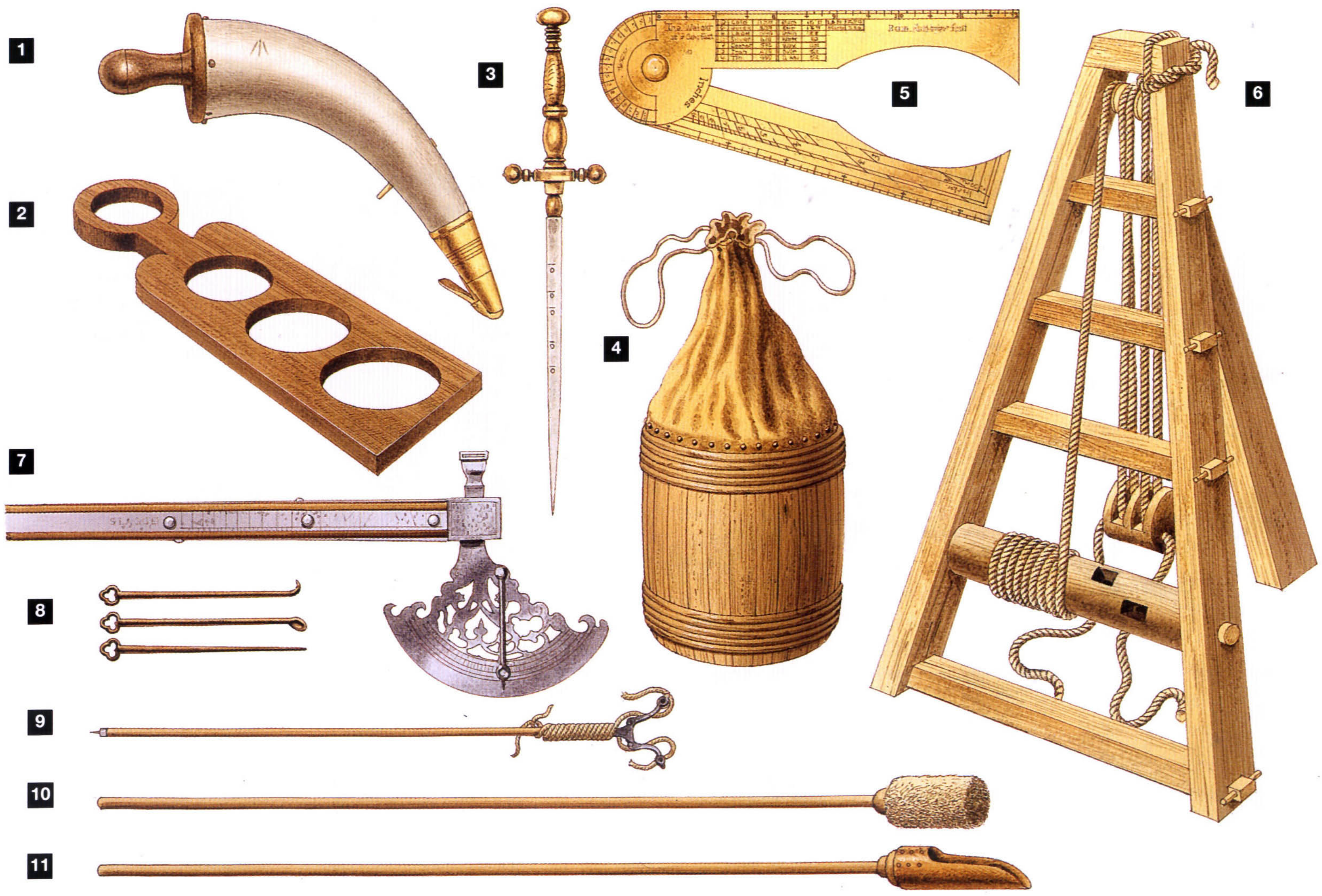
E: 17th-century artillery variations



F: Light field guns



G: A selection of tools and instruments used by gunners during the 17th century


1
3
5
6
2
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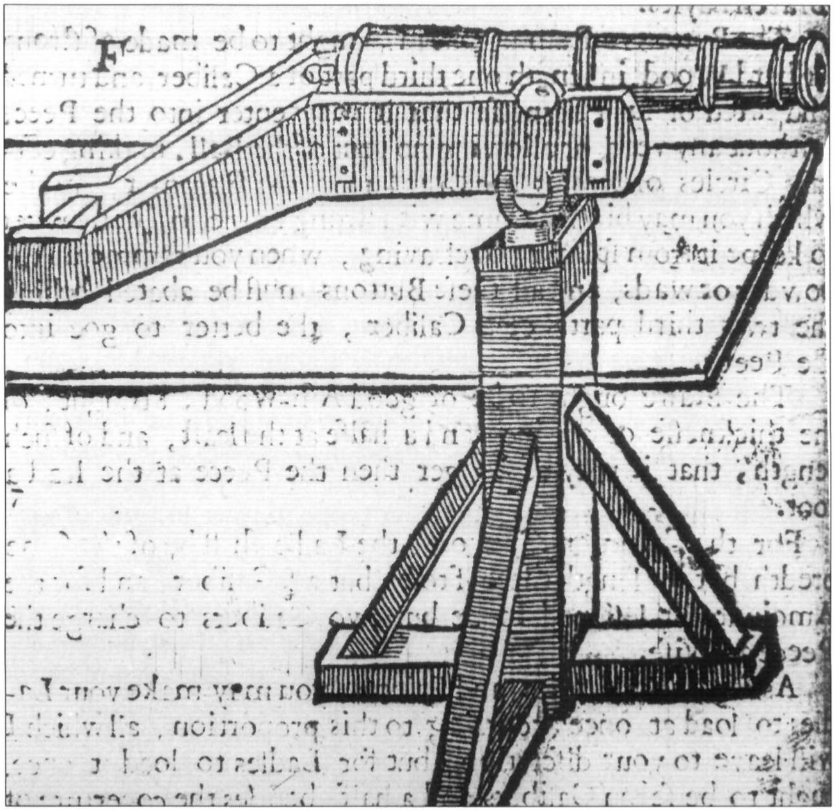
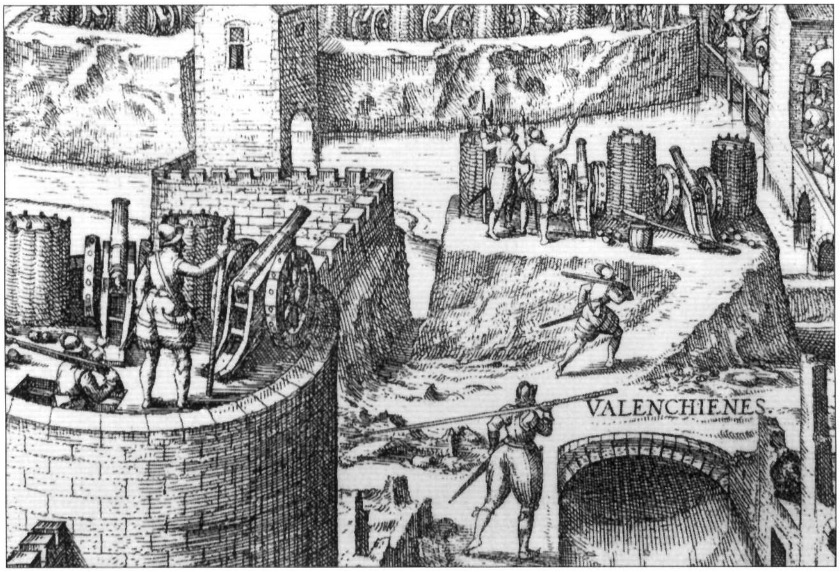
10
11
Inches

Spunge your peece – using the long stave the sheepskin head was moistened and then pushed down the bore of the gun. This had the effect of damping down any embers that were still smouldering in the gun and which would cause a premature explosion. The sponge could also be used to clean the bore.
Fill your ladle – this involved one man holding the barrel at waist height and the other pushing in the ladle until the head was full.
Put in your powder – it was then pushed down the barrel by turning it around and tapping the ladle at the end of the bore. Obviously if a cartridge was used this would not be required.
Empty your ladle – as above.
Put up your powder – this involved using the rammer to push the powder to the bottom of the chamber.
Thrust home your wad – the wad was rammed down the bore.
Regard your shot – the shot had to be examined to ensure that it would fit the bore correctly. Too little windage or too much would affect the way the shot would follow its trajectory.
Put home your shot gently – this was again done with the rammer.
Thrust home your last wad with three strokes.
Gage your peece – effectively checking the aim and elevation.

What Eldred does not mention is that the gunner then had to fill up the vent with priming powder and make sure there was a clear train to the main charge. Once the gun was primed it could be fired with the match applied from the linstock. Eldred makes great play upon the fact



Eldred's theoretical platform gun.



A very fine etching from a European manuscript showing the use of guns protected by gabions in siege warfare.

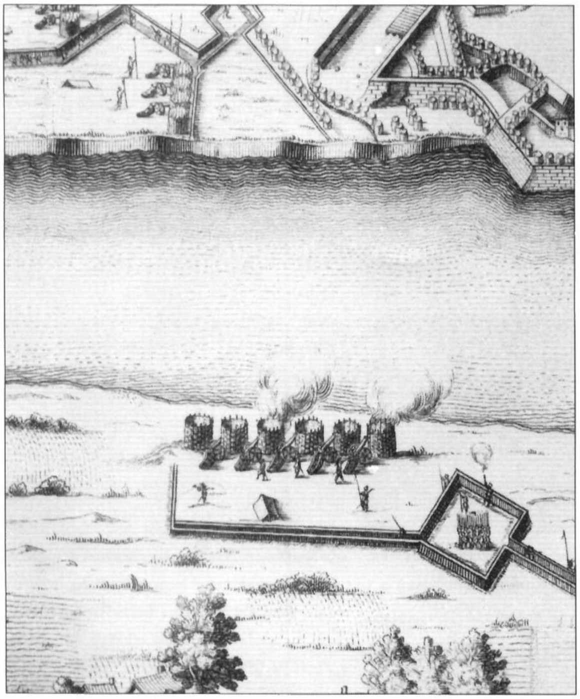
that before the gun can be fired it must have a 'dispart'. The reason for this was that the sighting arrangements had to allow the gunner to aim parallel to the axis of the bore. Aiming along the line of metal or along the top of the barrel would mean that the shooting was inaccurate. To correct this, gunners calculated the size of the dispart and prepared a little piece of wood or straw that was then attached to the top of the muzzle. Aiming at the target by a line from the breech ring to the top of this sight would then make shooting much more accurate.

According to Eldred the minimum number of crew required was three. One man handled the ladle and sponge while the other two provided wad and shot and held the budge barrel. Their positions were as follows:

> First let your two labourers or assistants be appointed to serve the one at the right hand, the other on the left, and neither of them to move into the others place till the Peece be charged. Let your right hand man bring your ladle and your spunge and place them on the right side of the Peece between the wheele and the carriage and stand you on the same right side, then let him provide a fit shot for the peece and lay it ready, let your left hand man provide two wads of Ocam, or hay or straw and wind them up round and light and place them between the spokes of the wheles that the wind not blow them away, then let him fetch the budge barill with powder, then to lay your peece to passe to load. (*The Gunner's Glasse*)

Mortars were treated differently. Firstly, the muzzle was elevated to near the upright position. Then the chamber was well cleaned and sponged and loose powder or a cartridge placed in the chamber with a wad of hay or oakum and a tampion (Norton calls it a tampkin) of soft wood fitted over the wad. The tampion and powder had to fill the chamber completely and after that another wad was placed over the projectile. If the mortar was to fire stone shot it would be elevated to the correct angle using a quadrant and then fired, but using an explosive grenado or shell required timing and practice.

TACTICS



Siege guns firing into a fortification. Although the scale is variable the guns appear to be in a prepared position some way away from the town. From a French manuscript of 1635.

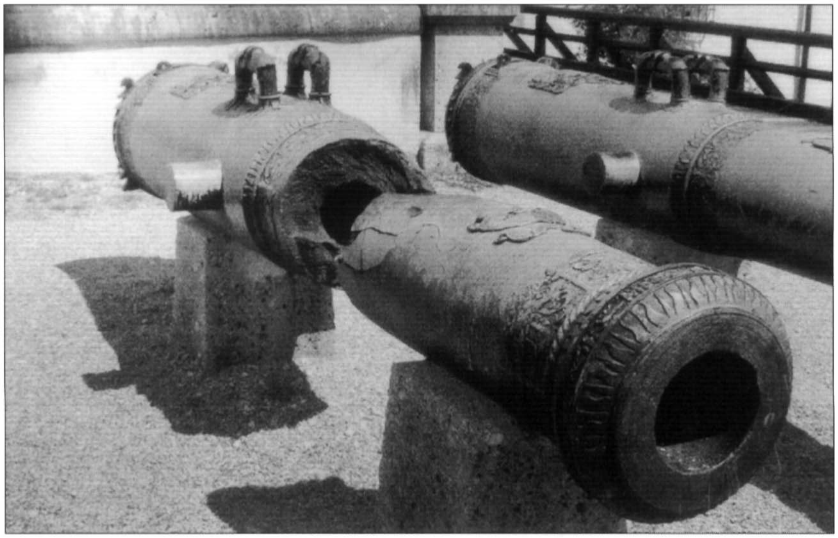
Most authors on the English Civil War are agreed that guns played a static role in the field. If this is so it is perhaps surprising that the commanders during the conflict viewed their guns as an essential prerequisite to the beginning of a battle. The Earl of Essex was notorious for this. It may have been that commanders were cautious but this is an unlikely explanation. The main advantage that field artillery gave to a field army was that of range. The maximum effective range of a musket during this period was no more than 100 metres and effective range was much less – around 60 metres. The range of a gun was 1,500 paces or 1,143m. At the end of its trajectory the round shot was travelling at slow speed but it could still do damage. At this sort of range the difficulty was that a gun had a very narrow area of damage. However, as can be seen from contemporary prints, conventional units of infantry consisted of a solid body of pikemen and musketeers. Any round shot hitting these units would plough a lane through the unfortunate unit with obvious consequences. The following excerpt comes from a Royalist account of the Battle of Hopton Heath in 1643:

> Att this tyme alsoe wee drew up our Cannon which was one very good piece and did great execucion for the first shott killed six of their men and hurt foure and the next made such a lane through them that they had little minde to close agayne.

If the range of the guns could be made to play on enemy formations before they came into direct contact with the opposing side's troops, the morale effect as well as the physical damage would obviously weaken an opponent's resolve to fight. Guns were normally placed in front of the main units of the battle line but they could, as was demonstrated by the Royalist heavy guns at Edgehill in 1642, be placed behind troops on a slight rise so that they could fire over the heads of their own troops. The opening cannonade could go on for many hours. Clarendon stated of the contest for Beacon Hill at the Battle of Lostwithiel in August 1644:

> ...which they no sooner quitted than the king posessed, and immediately caused a square work to be there raised, and a battery made, upon which some pieces of cannon were planted, that shot into their quarters, and did them great hurt; though their cannon, though they returned twenty shot for one, did very little or no harm.

This is not likely to have had that much effect since there were few cannon at the battle. Even so, cannonading the enemy's units could force



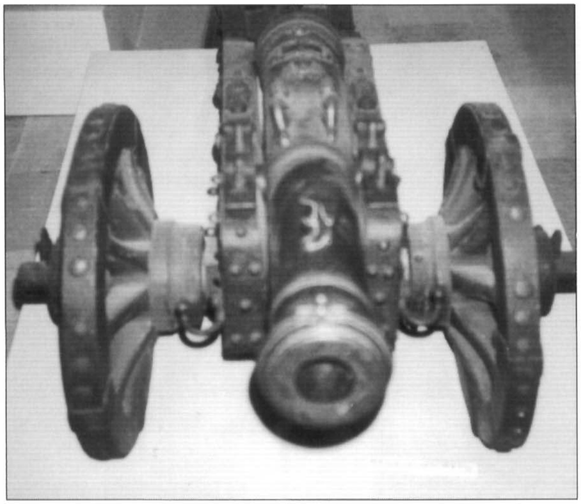
A good example of the risks of artillery. This gun, in the Bavarian Army Museum at Ingolstadt, has been blown apart in the middle of the chase. Accidents with guns and powder were not uncommon in the Civil War and lent weight to the belief that the gunner controlled a black art.

them to act, moving out of a good position, if they were in one, or detaching units to silence the guns. A clue from the Parliamentarian report on Marston Moor seems to indicate that this was the case: the artillery 'about two o'clock began to play upon the brigade of horse that were nearest, and did some execution upon them, which forced the enemy to leave that ground, and remove to a greater distance.' If the units were well trained and had high morale the cannonade would not necessarily affect them at all. The Marquis of Newcastle (later Duke) recorded that Royalist infantry were untroubled by the Parliamentarian guns when they fired upon their advance. In terms of the size of gun, it seems obvious that the larger the round shot the greater the damage will be. It is not always obvious why this should be and it is the hitting power of the round shot at the termination of its trajectory that makes the difference. A shot weighing 3 pounds has far less impact than one weighing 12 pounds. Even so, a gun as large as a full cannon would seldom if ever be seen on the battlefield. The author's experience of moving a replica saker of about 1¾ton weight around a muddy field has proved to him that even a saker would have been very difficult to relocate in the middle of a fast-moving battle – even with the help of horses.

Type of gun	Powder charge	Weight of shot	Point blank range	Maximum range
Cannon of 8	32lb	64lb	750ft	3750ft
Demi-cannon	24.5lb	16lb	850ft	4000ft
Saker	5lb	5.25lb	500ft	3750ft
Falcon	1.5lb	1.2lb	650ft	3000ft
Robinet	0.5lb	0.75lb	375ft	1750ft

(From Robert Ward, *Animadversions of Warre*, 1639)

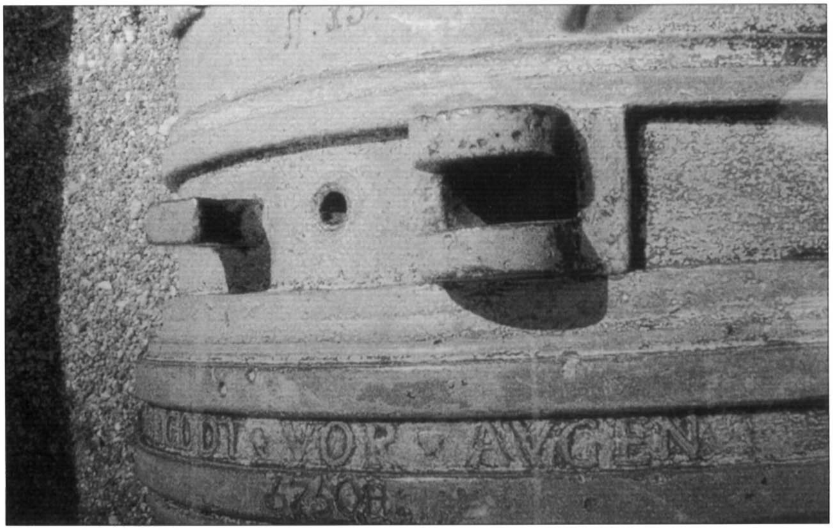
At Lansdown Hill near Bath in 1643, William Waller secured the advantage by placing his guns and his men on a hill and taking up a defensive posture. The continuous cannonading by Waller's guns forced the Cornish pikemen to attempt to attack uphill. In his initial position Waller had placed himself behind earth embankments and wooden



A fine example of a 17th-century model of a gun and carriage. The construction of the wheels and trail are in the correct proportions for a large field gun and show the massive hubs in comparison to the rest of the axletree.

obstacles. The guns had to be depressed to fire at the Royalists. The Battle of Newbury on 20 September 1643 saw the real effect of artillery: when on the receiving end of a cannonade Captain John Gwyn 'saw a whole file of men, six deep, with their heads struck off with one cannon shot'. Being part of a gun battery could be a risky business since the guns were in a position that, if overrun, would leave most of the gunners with only a short sword or their tools for defence. At Edgehill, William Balfour's cuirassiers overran a Royalist battery and killed all the gunners. It was impossible to spike the guns because of a lack of nails so the cuirassiers cut the ropes belonging to their horses. Presumably this refers to the towing ropes meant to move them but this is a poor way of attempting to disable a gun.

If large guns were problematic, the small versions were beginning to be used widely after the experience of the Thirty Years War. The Swedish General Gustavus Adolphus and the Dutch Prince Maurice of Nassau are generally credited with having introduced light artillery that travelled with infantry units. Falcons, minions and robinets were all considered to be useful in defending the gaps between the infantry units and it was possible to move them with the infantry to bolster the firepower of the musketeers. Most of the small brigade guns were under 3 inches in calibre and were generally muzzle-loaders. However, there are a great many examples of breech-loading guns in museums in Europe to suggest that breech-loaders existed on the field of battle and it would make sense for ease of reloading to use such weapons with grape shot or partridge shot. Perhaps this use of grape shot or partridge is the key to the use of smaller artillery pieces on the battlefield. A 2 or 3in round shot fired at close range is a serious threat but only affects a small number of people. Grape or partridge shot fired at close range is a distinct advantage because the wider cone of fire would affect far more men, cause more



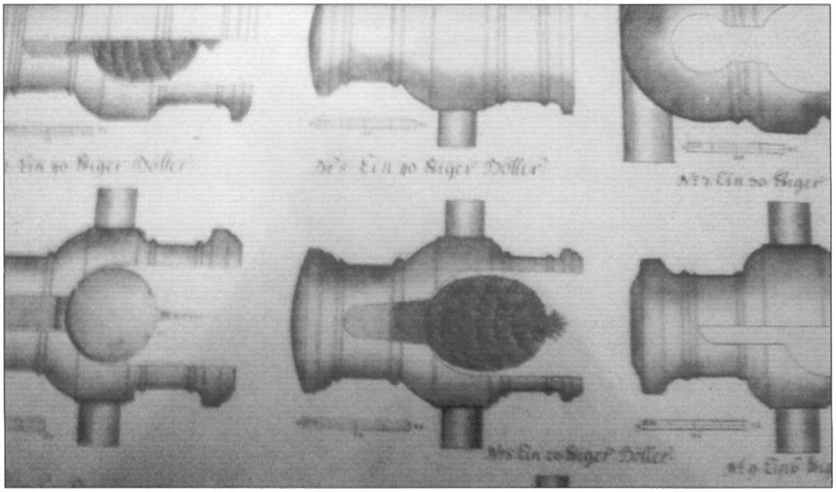
An early form of vent feature indicating that the gun was probably from the late 16th or early 17th century. The cover normally consisted of a flap that flipped over the vent and was hinged on one side.

Large stone shot of the type used as ammunition for perriers. Recent experiments have shown that a stone shot can travel at 141 metres per second when fired from a gun. This gives the projectile considerable impact velocity.

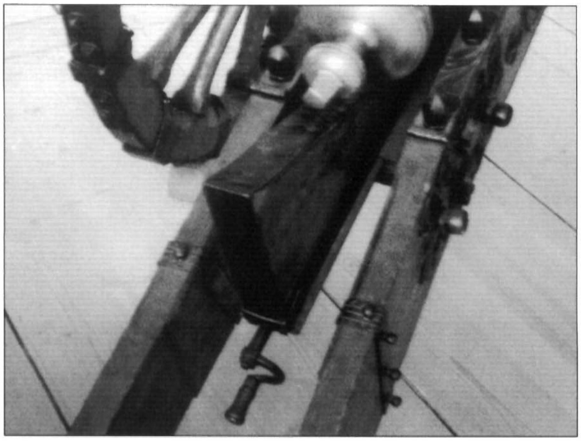
casualties and seriously disrupt a close formation. Some European examples of small bore guns are extremely sophisticated with ratchet-operated breech blocks and ready-made ammunition although it may have been that these were better suited for fortification purposes since they could be aimed more accurately. As an example of how European weapons may have entered the English Civil War, we may look no further than Lord Hamilton, who returned to England in 1635 after fighting for the Swedes in the Thirty Years War. He was presented with six cannon on his return and it is very likely that these guns were pressed into service.

ORGANIZATION

The organization of artillery trains is a difficult thing to define since most trains were raised on an ad hoc basis for a period of time. However, there are certain roles that occur with regularity and these we can define reasonably easily. The General of the Artillery was normally the leader of the train and responsible for its direction and upkeep and he supervised



A 17th-century illustration showing the various types of mortar projectile available to the gunner. The left-hand mortar appears to have been loaded with an explosive shell or grenado while the centre mortar appears to be loaded with an incendiary device. The upper right-hand mortar is of different construction with the trunnions at the breech and a circular chamber. This must have presented some problems in casting.



An alternative method of elevating the gun breech. This uses a winding handle to force the quoin under the gun, thus elevating or depressing it.

all of the subsidiary departments such as the gunners, fireworkers, conductors or drivers, pioneers and craftsmen. There was also a Lieutenant General who was the deputy to the General. The Master Gunner had a role that was subordinate to the Lieutenant General but he was expected to take over when the Lieutenant General was not available. His role was very much one of upkeep and maintenance and he was heavily involved in checking newly cast and bored guns. It was the Master Gunner's job to provide the side arms and replacement parts to the guns.

The gentlemen of the ordnance were senior gunners who were required to make professional decisions concerning sieges etc. They played a large role in ensuring that the guns were transported properly and then guarded once in camp. The gentlemen gunners normally looked after batteries (a modern word) of three or four guns. They observed fall of shot and corrected laying of the guns but they were expressly not to interfere with the guns themselves. Then there were the gunners. There were normally quite a few gunners on the lists for the train but it would be a mistake to assume that they manned every gun. It is clear that the normal soldier considered the gunners to be possessors of a black art and this could sometimes boil over into a hatred for them, especially when they decimated their comrades. In truth, gunnery was becoming more theoretical and was considered to be a discipline in which an intellectual could make his mark. Geometry and calculation were needed to find elevation and calculate the weight of charge and shot.

Normally a gunner commanded the gun but there were labourers and matrosses as well. Labourers were generally used for lifting and shifting but the matross was something in the order of a semi-skilled gunner and seems to have been entrusted with more complex tasks. The fireworker was another member of the train staff and his job was normally to make up pyrotechnics, see to the condition of the gunpowder, make up mortar shells and generally take care of explosives.

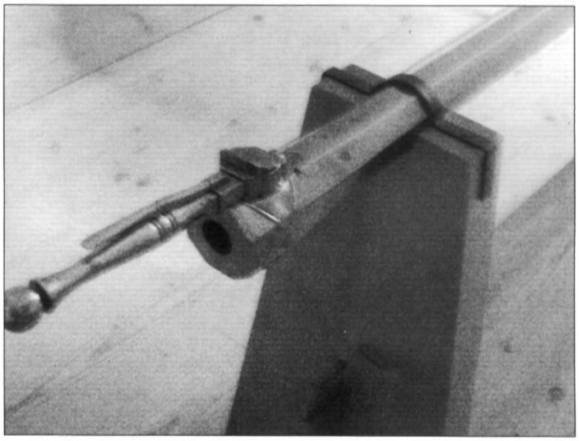
In order to protect the train the guards were normally armed with firelocks. It was thought that the matchlock musket posed a far greater risk than a flintlock weapon and so early versions of this weapon were issued.

SIEGES

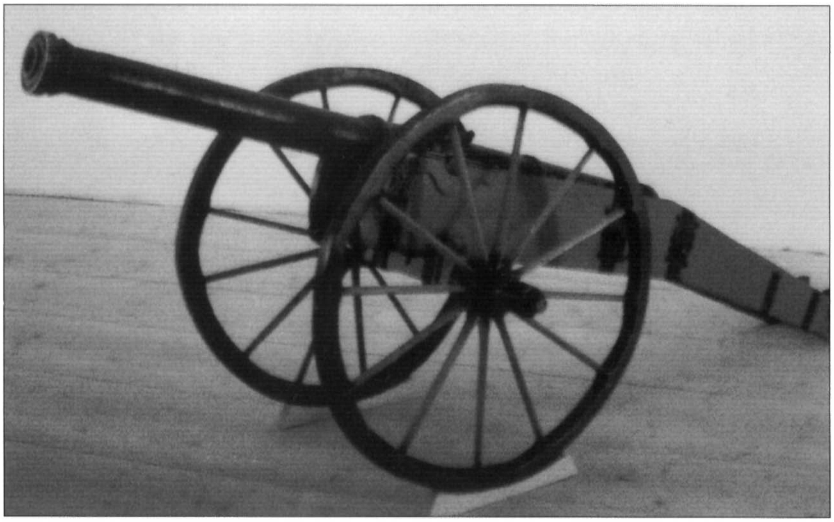
Sieges in the first part of the war were haphazard and often not well prosecuted. Often the building being besieged was not designed to withstand the attack of artillery. As the war dragged on they were carried out in a much more methodical way. The Parliamentarian train that accompanied the New Model Army was very powerful and was increased as the army came under control of the Commonwealth. There were many fortified places in Britain in the 1640s, some of which were more important or better placed strategically than others. It cannot be emphasized enough that their defences were themselves of widely varying condition. Hull, having been designed by the Tudor engineer John

Rogers, was considered to be extraordinarily well defended, while at the siege of Newcastle on 19 October 1644 the walls were unprotected by earthworks and breaches were effected very quickly, forcing the defenders to scamper around trying to find ways of defending them. In most respects artillery was far more important for siege work than for the field. Both guns and mortars were essential to the attack or defence of fortified places. This is one of the reasons why Civil War commanders were forced to create large siege trains and with them all the paraphernalia of supporting them. The artillery train was not only responsible for guns but for the supply, repair and delivery of weapons. It was very common for the train to include pioneers, carpenters, blacksmiths and other such skilled men. The artillery train was not, of course, the only form of siege weapon and we must not lose sight of the importance of the navy during this period. Parliament's almost complete domination of the navy through the Earl of Warwick gave them a massive advantage not only in sea transport but also in mobile firepower that could be used to support a siege. In fact, land and naval guns became somewhat interchangeable and the Earl of Warwick was, often under duress, obliged to remove them from ships in order to lay siege to a fortress or castle.

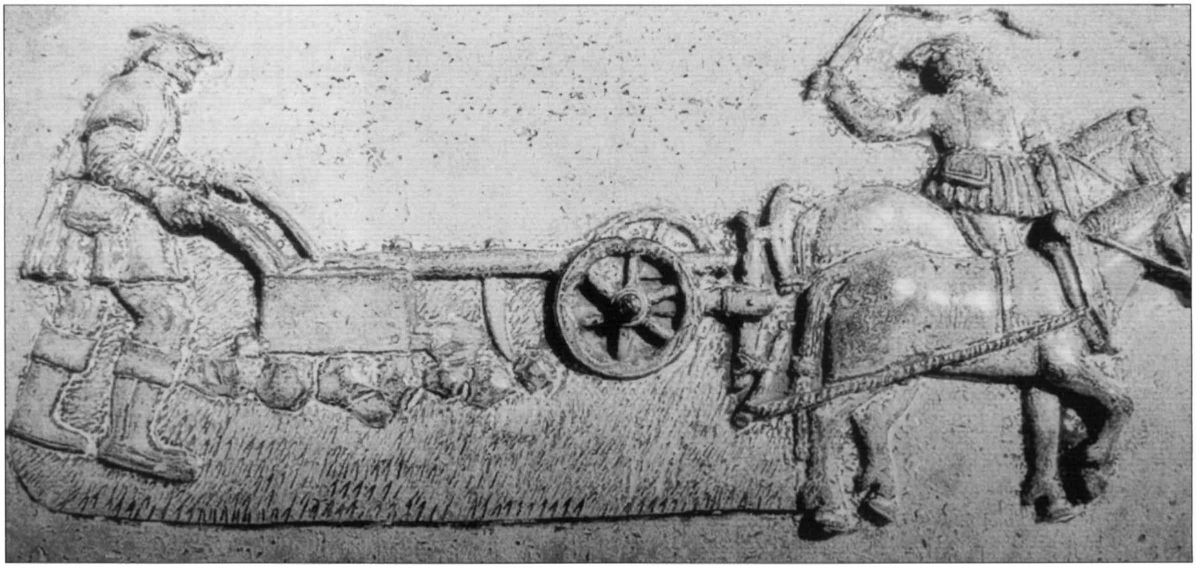
The attack of fortified places required a detailed examination of the place to be attacked. William Eldred put great store by this examination and logically it allowed the gunner to decide the best way or place to site his guns. Normally a siege required the besiegers to erect lines of circumvallation or fortified trenches all the way around the fortification. This allowed them to place guns and keep the attacking infantry in safety. The besiegers would then dig trenches in zigzags towards the enemy fortification so that either miners could get within striking distance of the walls or the gun batteries could be moved closer for better effect. Nevertheless, the largest gun, the cannon, would not take



Another view of a gun that uses a different technique for breech loading. In this case the handle is squeezed together and rotated, moving a circular block within the gun. The block is pierced by a hole big enough to pass the projectile and charge through.



A complete leather gun and carriage in the Bavarian army museum at Ingolstadt. The carriage appears to be original and is very finely made, as is the gun barrel. The wheels are not made to carry heavy weights, hence the spokes are slender and there is little reinforcing on the felloes.

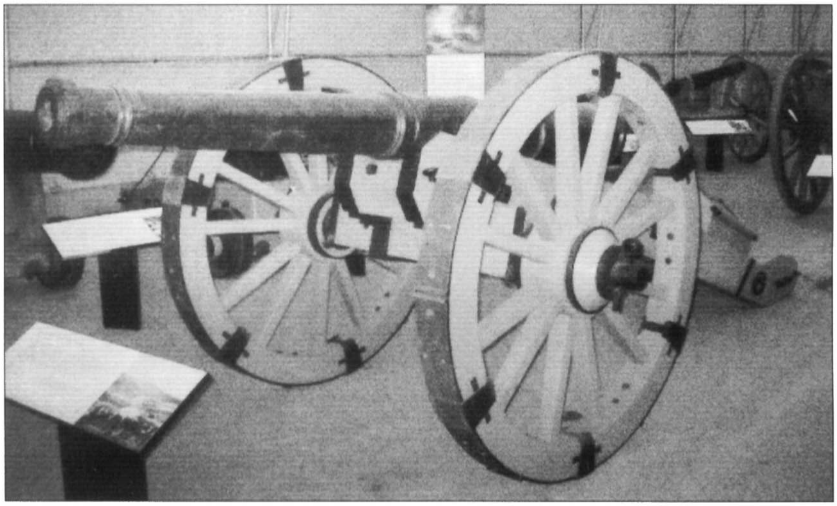


A very interesting detail from a German gun barrel from the early 17th century. This casting shows the method used to pull a plough and gives reasonably good detail of the horse equipment required to pull it. The swingle trees or short wooden bars behind the horse are very reminiscent of later gun carriage equipment but it may well be that they were being used to pull guns and limbers during the Civil War. In fact with the plough removed the wheels and draw bar are very similar to those illustrated in manuscripts and it may well be that the one led to the other.

very long to destroy even the stoutest of walls. Gunners generally aimed to fire an inverted T pattern on the wall at its base to weaken it and hopefully bring it down under its own weight. Guns were emplaced in batteries. A battery normally consisted of a levelled position with earthen banks and defended to the front by gabions. These gabions were large baskets made from the intertwined small branches of local trees and filled with earth. Earth was commonly piled up around them to form an embrasure through which a gun barrel would fire. The guns would be mounted on wooden platforms and they would be sited as near as possible to the enemy position without exposing the gunners to the fire of enemy guns or muskets. Small powder stores were built in the vicinity and were often covered with fascines to protect them. The guns were normally of large calibre and typically the cannon, the demi-cannon, and the culverin were the three preferred guns, but often, if the place was well fortified, the culverin, with its 15–16lb round shot, was not enough to pierce a thick-walled castle. The two larger pieces could throw a projectile of up to 63lb in weight and very little could survive the continuous bombardment of such weapons.

In order to hit the target, the gunner was required to set the elevation on the gun to get the correct range. In the Civil War this was done through the use of a quoin or triangular wooden block placed under the breech of the gun. Normally a gunner's quadrant was used to measure the angle of the gun barrel. The gunner placed the quadrant in the muzzle of the piece with the scale and plumb bob at the muzzle face. The gun could then be adjusted until the angle was correct. Other types of quadrant functioned similarly but were placed on the breech of the gun. As has been stressed, the mortar was the weapon that caused most consternation. At the siege of Gloucester in 1643, mortars were used to devastating effect. The governor, Edward Massey, stated:

> The enemy still prepared for a general storm . . . shooting grenades, fire-balls and great stones out of their mortar pieces. In one night they shot above twenty fiery melting hot iron bullets; some eighteen



One of the finest bronze sakers in existence in Britain today, mounted on a replica gun carriage, information for which was taken from von Wallhausen's Manual of 1617. This gun is known as the Phillips gun as it was cast by Richard Phillips in 1601. It was not, however, used in the Civil War since it was recaptured from the Chinese in 1842. It was probably captured from an English ship and it is inscribed with Chinese characters. Nevertheless, it is exactly the type of gun used in the field during the Civil War and gives a good idea of the size of such pieces. The barrel is 9ft 8in long and the bore is 3$^{3}/_{4}$in. (Courtesy of the Trustees of the Royal Armouries)

> pound weight, others two and twenty pound weight, which were seen to fly through the air like the shooting of a star. (Young, *Sieges of the Great Civil War*)

Once the breach had been made the generally preferred method of reducing the town was to storm the breach to get inside.

The vexed question of the effectiveness of artillery in the Civil War is not a simple matter to answer. The utility of guns during a siege was indisputable but the effectiveness of artillery depended as much on the skills of the gunners and the placing of the guns as it did on the reluctance of the target units to endure their fire. The ability to use guns in new ways was only in part understood in the Civil War and thereafter the use of artillery changed very little at least until the Napoleonic Wars. The Duke of Cumberland could be seen aligning his guns between his units in the front line at the battle of Culloden. Incremental changes in the use and preparation of artillery can be seen, but not until the latter half of the 18th century did its use become much more mobile. Although there had been refinements in the use and production of artillery, the gun barrels that were used in the Crimean War were still smooth bore muzzle-loading guns that would not have appeared alien to the members of the artillery trains of the 1640s and 50s.

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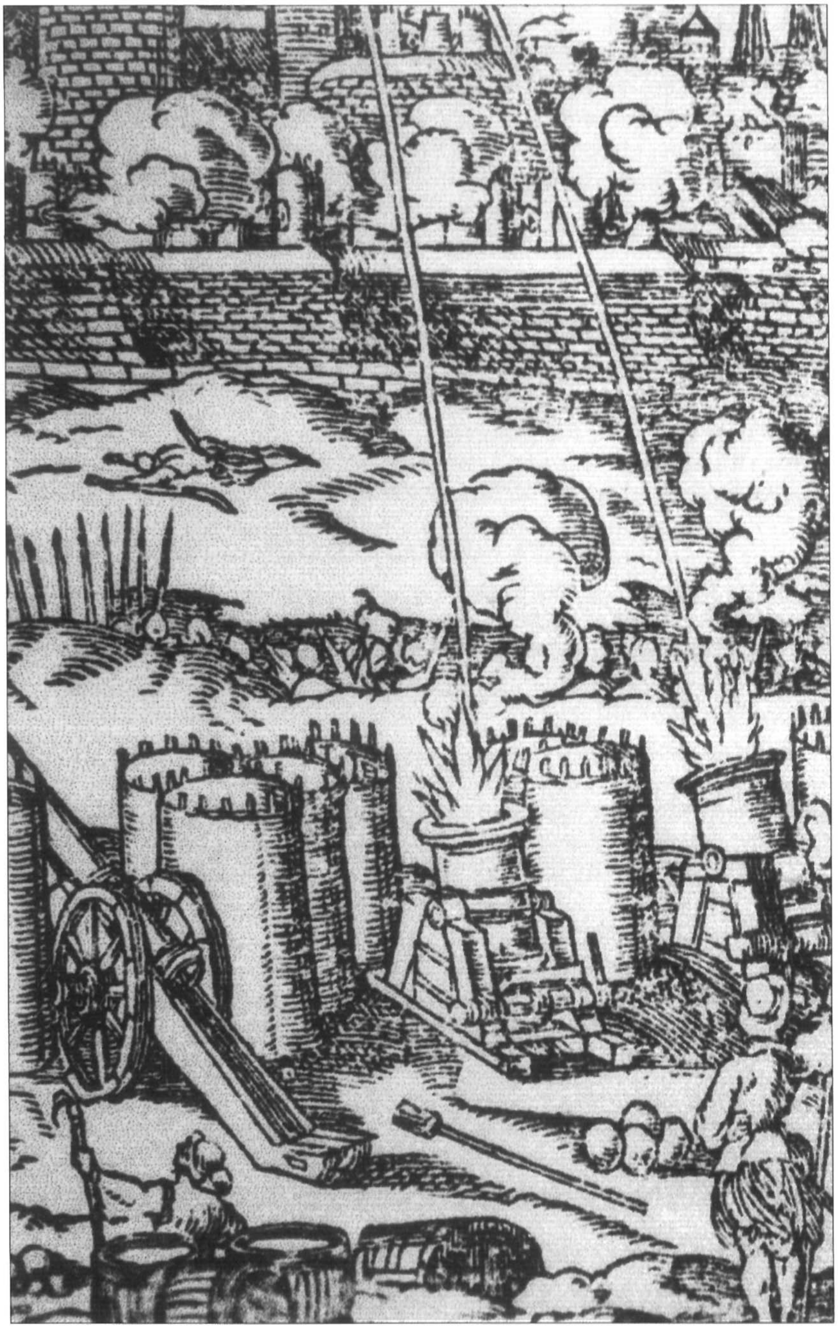
Detail of a 17th-century woodcut showing the use of mortars during a siege. This image implies that the mortar was mixed in with a normal gun battery during siege work. Their effect was such that 'they annoy the enemy much in his Forts and trenches' (Ward, *Animadversions of Warre*). Although they were used to fire shells they were sometimes used to fire showers of small stones. What effect this had is unclear.



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GLOSSARY

Axletree the wooden baulk used to mount the wheels and normally fixed under the cheeks.

Apron of lead a lead cover to prevent damp entering the vent. This was often placed over the fid.

Base ring the part of the breech that defines the end of the bore. Normally the base ring was marked by a raised moulding that went around the circumference of the breech. It was often inscribed with the maker's name and the date on which the gun was cast.

Breast loop the iron loop embedded in the breast transom.

Breeching rope a large-diameter rope used to control the recoil of the gun by passing it through the breeching loop or tying it around the cascable button of the gun. The rope was secured to iron loops in the ship's side.

Extree another name for axletree.

Carnous (sometimes spelt carnouz) a somewhat esoteric term used by some commentators to describe the part of the gun breech behind the base ring.

Cascable also used to describe the rear portion of the gun barrel behind the base ring.

Eye bolt a long bolt that passed through the top of the cheek and terminated under the side of the gun carriage, thus securing the cheek pieces together.

Fid or vent plug a small piece of twine or even a wooden peg placed in the vent when not in use.

Grenado a term used to describe a hollow projectile filled with gunpowder and exploded by a fuse. It could be made of iron, clay or even glass.

Handspike a stout bar used to lever the gun carriage or barrel.

Limber a two-wheeled carriage with shafts to fasten the trail of travelling carriages by means of a pintle or iron pin. Also called a lymore.

Lynch pin the iron pin that passed through the axletree and secured the truck on the axle.

Priming iron a tool for clearing the vent and piercing the cartridge case. This was normally a non-ferrous metal spike.

Quoin a triangular wedge of wood placed under the breech of a gun to elevate and depress it.

Sponge a staff with a large sheepskin head used for damping down burning embers and cleaning the gun barrel.

Stool bed the flat wooden plate upon which the quoin and therefore the breech of the gun rested.

Rammer a long staff with a cylindrical wooden head usually slightly smaller than the bore, used to ram home the powder and cartridge.

Truck the name used for the small wheels fitted to a sea service carriage.

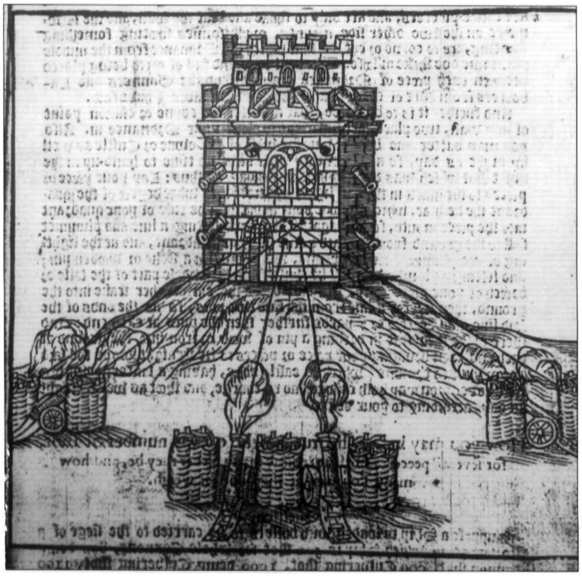
Trunnions cylindrical projections cast into the middle portion of the gun so that it can be elevated and depressed.

Worm or **wadhook** used to scour the inside of the barrel to remove burning embers or blockages. It consisted of a wooden staff with a spiral iron hook on its end.

COLOUR PLATE COMMENTARY

A: THE SIEGE OF BASING HOUSE

The siege of Basing House was one of the most celebrated events of the Civil War. There were in fact three sieges and the illustration shown here is during the siege of 11 July 1644 when the Parliamentarian Colonel Richard Norton laid siege to the Marquis of Winchester. The first siege had proved difficult so the second was intended to be carried by artillery at a distance. Two large mortars were sent to the siege on 20 July with 'divers grenadoes' to cause the besieged trouble. It is thought that these mortars were able to fire stone as well as mortar shell. They arrived on 28 July and lobbed 36lb stones into the house as well as grenadoes or shell. The shell were more likely to have been the terror weapon because their explosive capability could not be defended against. Loading the mortars was a time-consuming and dangerous business as the shell had to be loaded and then slung on a bar with two chains to be placed in the muzzle. it is not clear when the idea was hit upon that the burning of the propellant would light the fuse at the same time but some manuscripts mention it whereas others do not. The greatest fear was that the shells would explode in the mouth of the mortar before being fired and so they were often coated with a form of paint to prevent this.



ABOVE **Detail from *The Art of the Gunner* by Nathaniel Nye showing the method of destroying the wall of a fortification. Each gun is trained to fire on roughly the same spot, thus weakening the wall. The creation of a breach often only took a few hours with the right kind of artillery and skilled gunners.**

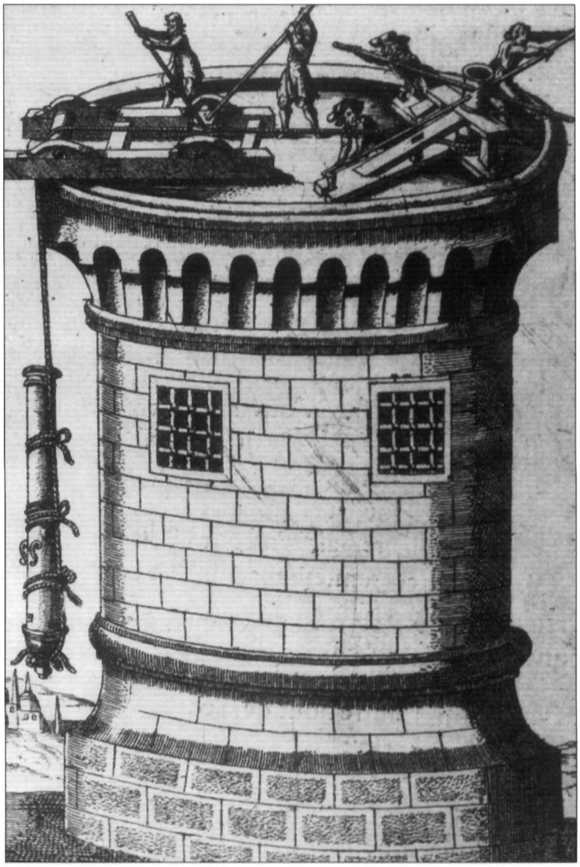
RIGHT **Many 17th-century illustrations show guns mounted on carriages and placed in the uppermost tower of a fortification. This interesting plate shows how the gun was placed there.**

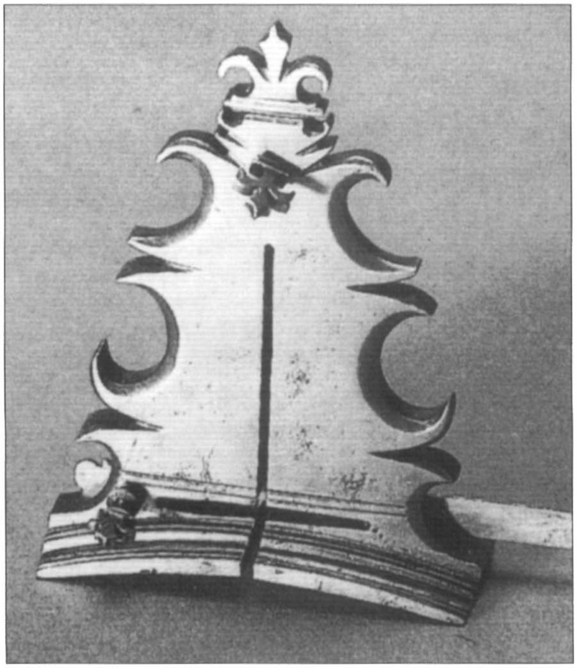
B: THE BATTLE OF EDGEHILL

This is the sort of view the gunners would have had as the enemy approached the guns. Normally a cannonade opened the battle to weaken the enemy units and disrupt their battle line. Both guns have a crew of four men and they are standing waiting to fire. On loading, both of the front men would move to positions between the wheels and the barrel. When the gunners were about to fire, the crew would retire behind the gun either side of it. This was not always the case and Eldred points out that he had seen many gunners who did not carry out good and sensible drill.

C: ARTILLERY ON THE MARCH

This plate shows several methods of transporting and towing guns for a siege train. It was not unusual for labourers to have to manhandle guns, especially in difficult terrain. Here the middle gun is towed by attaching ropes to the drag hooks on the wheels of the gun and lifting the trail. The carriage at the back of the train is called a drug and was intended to carry the barrel only. A gyn was used to lift the barrel off the cart and place it on its field carriage. This train could extend for several miles depending upon the number of guns being transported. All of the ancillary workers such as coopers and waggoners were attached to the train and other weapons were supplied from it.





An Italian gunner's sight. The object is made of brass and is pierced with an aperture vertically. The gunner placed this sight on the breech of the gun and aimed through the aperture.

D: THE SAKER AND ITS COMPONENT PARTS

This image is copied from the German book on guns by Jacobi von Wallhausen dated 1617 and gives a good impression of the construction of the gun carriage. Similar texts in England and Spain show almost identical construction techniques but this is one of the finest images of a gun and all its parts. The gun drawn here is meant to represent a saker or a gun of 5–6lb shot weight. See plate for further details.

E: 17TH-CENTURY ARTILLERY VARIATIONS

There were many different types of light field gun and they were used for various purposes:

1. Iron gun on naval carriage as drawn from photographs of the iron gun at Windsor Castle. The iron gun is similar to one in the collection of the Royal Armouries.

2. *Petiero a braga* or wrought iron breech-loader

Typically this type of gun has been dated to the 15th century but more recent studies have shown that it was in use throughout the 17th century. The powder is loaded into a small iron chamber at the rear of the gun and is held captive by an iron stirrup to which a tiller is attached. This type of gun is associated with naval use but could easily have been adapted for fortifications.

3. Eldred's platform carriage

This unusual design is a copy of the illustration in Eldred's *The Gunner's Glasse* on pages 37 and 38 which describes the replacement of the axletree with an oak bar. The centre of this bar was to have a hole one calibre in diameter and lined with iron. The tail transom was to be fitted with a wheel which would 'turn the piece about when she is shot off'. The post, as we can see here, was actually set into the ground with one foot of the post showing above it. It appears that Eldred intended to mount the carriage on a spindle as shown here and have the trail rest on the ground. When the gun fired, the post dug into the ground took the recoil. He stated that he had tried the carriage but whether it was ever of any practical use is debatable.

4. Robinet

Representative of a gun of bore about $1\frac{1}{2}$in in diameter, the weight of the shot would have been about $\frac{3}{4}$lb. The barrel could be of iron or bronze but tended to be anything from 4 to 8ft in length.

5. Robinet barrel

A similar barrel to E4 but viewed from the rear.

6. Drake

Described in Hexham as having a bore of $3\frac{3}{4}$in and with weight of shot of 6lb, the length and weight of the gun being 5ft and 580lb. This version has been drawn with a dispart sight cast into the barrel which was rare but not unknown. The carriage is heavily made and has iron reinforcing bands on its wheels and trail.

F: LIGHT FIELD GUNS

1. Leather gun

A very fine example of a leather gun from the Heeresgeschichtliches Museum in Austria. This gun dates to 1640 and the barrel is 9ft 9in long. The carriage is extremely well made but light, taking advantage of the lessened weight. Clearly this weapon is not intended to be used for a few shots but is obviously intended for longer use, in contrast to those made by the Scots in the Civil War.

2. Falconet on field carriage

This gun and carriage is one of the very few examples of a gun carriage that was made at the very end of the 17th century and thus is later than the Civil War. However, it is a good example of the lengths to which guns could be decorated. It was a gift to William, Duke of Gloucester, from the City of London, and the carriage was made in 1699. It also gives us a close glimpse of carriage construction in the 17th century. The gun was called a falconet when it was cast. The plates linking the felloes in the wheels, and the strakes nailed to the outside of the wheels, are all typical of guns constructed during the Civil War period. This carriage is much more finely made as it was intended to be given as an ornate gift rather than to be used as a weapon.

3. Iron gun

Iron gun on parapet carriage dated 1635, from the Heeresgeschichtliches Museum in Austria. Two similar weapons exist in the Royal Artillery Museum in the Rotunda and at Firepower and are similar in construction and appearance. This type of carriage may have been designed to fire over a parapet or from fixed positions. The example at the Rotunda has a traversing mechanism so that the gun can move from side to side. In Europe these weapons are often breech-loading and later examples of such weapons have a small, prepared, cartridge to be used with them. This may suggest they were intended for rapid firing. The three examples quoted here are all breech-loaders and the swivel may have been so that the gun could be turned and loaded easily. The long length of the barrel, in this case 8ft, would make it awkward to load in a fixed position.

G: A SELECTION OF TOOLS AND INSTRUMENTS USED BY GUNNERS DURING THE 17TH CENTURY

1. Powder horn

The powder horn changed very little during its use in the 17th century. Some could be a simple horn with a removable end piece and others could be much more elaborately carved.

2. Shot gauge

A simple shot gauge made from wood as illustrated in the 17th century. It would be placed over the shot to see which projectile best suited which gun.

3. Gunner's stiletto

Apart from being a highly elaborate form of dagger, the gunner's stiletto was a symbol of office as well as a useful tool. The blade was marked off in a scale that would, when measured at the bore of the gun, give the weight of the shot required for that gun.

4. Budge barrel

A wooden gunpowder barrel with a leather liner that was used to supply powder near the gun. The leather inner was tied up when not in use. In many respects it was an early form of safety device.

5. Gunner's calipers

Gunner's calipers took many different forms and this flat-bladed hinged type was typical of the English style. Similar forms can be seen in Eldred's and Norton's texts. They could be used to measure the width of the gun bore or shot and had useful mathematical tables engraved into them.

6. The gyn

Again copied from the images in Robert Norton's book, this image shows a sturdy wooden form with a block and tackle and axle on one side. The hook of the block was attached to the dolphins and the gunners placed levers in the slots cut into the axle to turn it, thus lifting the barrel.

7. The gunner's quadrant

The highly ornate instrument in this illustration is copied from a German quadrant made in 1585. It was used by sighting along the staff through two notches on the upper surface. The elevation was read off the scale on the quadrant and then the haft of the quadrant placed in the barrel of the gun and it was elevated to the same angle indicated on the quadrant.

8. Vent tools

Small tools were used for clearing the vent of the gun and in particular for punching a hole through the cartridge bag if there was one. The powder horn could then fill the vent with loose powder prior to firing. They tended to be made from a non-ferrous metal to avoid sparks.

9. The linstock

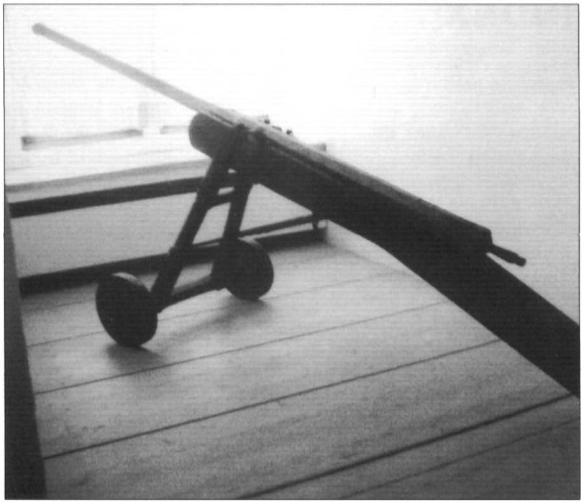
This was a staff surmounted by an iron head, often elaborately inscribed, which held the burning match used to light the powder train.

10. Sponge

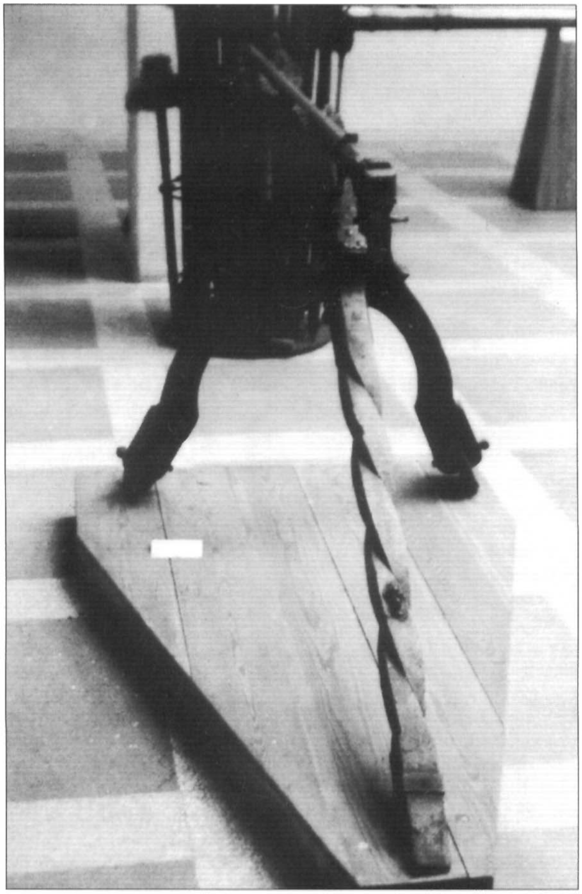
A simple sheepskin sponge for damping down embers in the gun and for cleaning the bore.

11. Ladle

A copper-headed ladle for placing the propellant charge in the bore of the gun.



ABOVE **An iron gun mounted on a parapet carriage. The mounting is a reproduction but the gun itself raises some interesting questions about such weapons. Reloading would have required the gun to be withdrawn right back away from its firing position and required a great deal of length to allow the gunners to carry out loading drill.**



BELOW **This very small bore breech-loading gun has counterparts in Moscow, Italy and Malta and is an early example of a breech-loading smooth bore. It is part of the collection in the Army Museum of Vienna. (Author's photograph)**

INDEX

Figures in **bold** refer to illustrations

accidents with guns **36**
ammunition 18–20
  grenades (grenadoes or shell) 13, 18–19, **38**, **A**
  incendiary devices 20, **38**
  manufacturing **17**, **20**
  mortar projectiles **17**, **38**
  quantities 20
  shell *see* ammunition, grenades
  shot 18, 37–38
  shot, stone 7, 18, 34–35, **38**
armies in the field **7**, **8**
arsenals 11 *see also* ordnance stores
Art of Gunnery, The 8–9, **45**
Art of Shooting Great Ordnance, The **12**
artillery, field 4
artillery, siege 4, 9
artillery trains 38–39, 40
artillery variations, 17th-century **E**

Baber, William 19
Balfour, William, cuirassiers 37
barrel, vent feature **37**
barrels, mounting 23
Basing House, siege of **A**
Bavarian Army Museum, Ingolstadt **36**, **40**
bore, manufacture 7, 8
bore, measuring **23**
bore, types of **12**
breech, casting 7
breech, elevating **39**
breech loading **40**
Browne, John, and family 4–5

carriages 13–16
  axletree 13–14, 15, 16, **D**
  cheeks 13, 14, 15, **D9**
  field **F2**
  four-wheeled (drug) 22–23, **C**
  galloper 17
  land service **13**
  leather gun **40**, **F1**
  naval 18, **E1**
  parapet **47**, **F3**
  platform, Eldred's **E3**
  and plough pulling **41**
  transoms 14, 15, **D7**, **D8**
carts **15**
casting guns 5–9, **18** *see also* manufacture
  chaplets 7
  dead head 6, 8
  decorations 6
  trunnions 6
Cecil, Sir Edward 10
Charles I, King 5, 19
Cropredy Bridge 17
Culloden, Battle of 42
Cumberland, Duke of 42

Diego Ufano **14**, **15**
Dover Castle 10
drill 24, 33–35
  loading and firing **19**
Dutch traders 4

Edgehill, Battle of 37, **B**
Eldred, William 9, 10, 14, 15, **21**, **33**, 33–34, 40 *see also Gunner's Glasse, The*
Elizabeth of Bohemia 20
Essex, Earl of 35

fire, arcs of **24**
fortifications **6** *see also* sieges
  destroying walls in 40–41, **45**
  how guns were placed in **45**

gabions **34**, 41
General of the Artillery 38–39
Gloucester, siege of 41–42
gun types 9–13
  base 9, 10, 12
  basilisk 10, 23
  bastard 10, 11, 12
  battering 9
  breech loaders **3**, **12**, 37, **E2**
  bronze **3**, 4, **12**, **42**
  cannon **5**, 12, 13, 41
  cannon of 7/of 8: 9, 12
  cannon perrier **5**, 7, 9, **38**
  culverin **5**, 9–10, **12**, 12, 13, 16, 41
  demi-cannon 9, 11, 12, 13, 41
  demi-culverin 9, 11, 12, 20
  drake 9, 10, 12, 13, **E6**
  falcon 9, 10, 12, 13, 24, 37
  falconet 9, 11, 12, 13, 15, **F2**
  field, light 16–17, 37–38, **F**
  finbanker 4
  fowler 10, 12
  frame 16–17
  iron **3**, **13**, **47**, **E1**, **F3**
  leather 16, **40**, **F1**
  minion **4**, 9, 10, 11, 12, 16, 37
  mortar **5**, 10–11, 12, 13, 16, 34–35, **38**, 41–42, **43**, **A**
  murderer 10, 12
  organ (orgue) 17
  parapet, mounting **21**
  Petriero a braga **12**, **E2**
  platform **33**, **E3**
  port piece 10, 12
  robinet 9, 12, 24, 37, **E4**, **E5**
  saker 9, 10, 11, 12, 13, 16, 20, 36, **D**
  saker, bronze (Phillips gun) **42**
  seven barrelled brass 12
  siege **35**
  three barrelled brass 12
  wrought iron **3**, **13**, **E2**
Gunner's Glasse, The **16**, 24, 33, **E3**
gunners 18, 21, 39
gunpowder and mills 19–20
Gustavus Adolphus, General 37
Gwyn, Captain John 37

Hamilton, Lord 38
Hamilton, Sir Alexander 16
Hopton Heath, Battle of 35
Hull 11, 39–40
  ordnance stores 3, 11, 13

instruments, gunners' *see* tools and instruments

James I, King 20

Lansdown Hill 36
Lieutenant General 39
limbers **15**, 22
London 19
  ordnance stores 3
London, Tower of 11
  inventories 11–13, 20, 22
Lostwithiel, Battle of 10, 35

manufacture 4–5, 11 *see also* casting guns
Marston Moor, Battle of 36
Massey, Edward 41–42
Master Gunner 39
Master of the Ordnance 11
Maurice, Prince of Nassau 37
Memorialls of Troubles in Scotland 17
model gun and carriage **37**

New Model Army 3, 39
Newbury, Battle of 37
Newcastle, Marquis (later Duke) of 36
Newcastle, siege of 40
Norton, Colonel Richard **A**
Norton, Robert 9, 19, **22**, **23**, 23, 24
Nye, Nathaniel 8–9, 20, 23, **45**

Ordnance, Board of 11
ordnance, gentlemen of the 18, 39
ordnance stores 3 *see also* arsenals
organization 38–39
Oxford 5, 19

Phillips, Richard **42**
Pitt, Henry, and family 5
propellants 19–20
proving guns 8–9

'Queen Elizabeth's pocket pistol' 10, 23

range 35, 36
Rogers, John 39–40
Royal Artillery Museum, Woolwich 15, 16

Sea Gunner, The 18
sieges **34**, **35**, 39–42, **43**, **45** *see also* artillery, siege; fortifications

tactics 35–38
Thirty Years War 37, 38
tools and instruments **19**, 20–21, **D**, **G**
  linstock **10**, 33, **G9**
  measuring device (gunner's calipers) **16**, 21, **G5**
  quadrant, gunner's 21, **22**, 41, **G7**
  sight, gunner's **46**
  sighting rule (gunner's calipers) **16**, 21, **G5**
  stiletto, gunner's 21, **G3**
transport **14**, 21–24, **C**

Waller, William 36–37
Warwick, Earl of 40
Weald, Sussex 4
Weymiss, James 16
Windsor Castle 18

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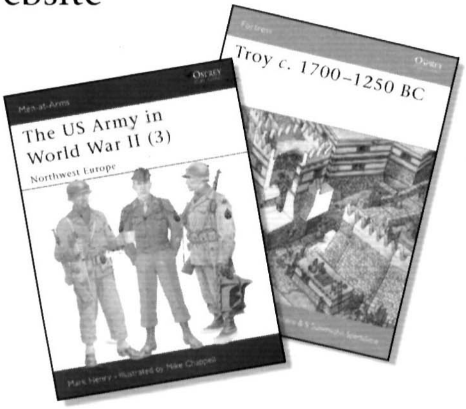

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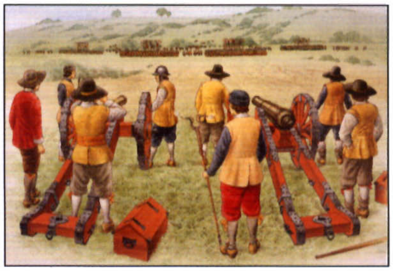

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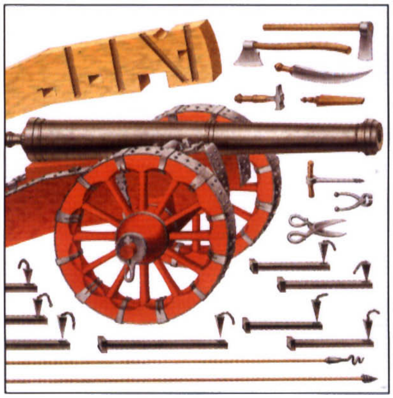

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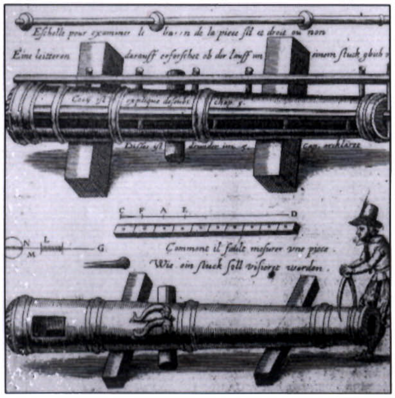
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